PB86-121704

EPA (Environmental Protection Agency) Method Study 31: Trace Metals by Atomic Absorption (Furnace Techniques)

Energy Resources Co., Inc., Cambridge, MA

Prepared for

Environmental Monitoring and Support Lab.
Cincinnati, OH

Oct 85

U.S. Department of Commerce
National Technical Information Service
NTIS.

PB86-121704

EPA/600/4-85/070
October 1985

EPA METHOD STUDY 31:
TRACE METALS BY
ATOMIC ABSORPTION (FURNACE TECHNIQUES)

FINAL REPORT

by

T.R. Copeland & J.P. Maney
ERCO/A Division of ENSECO
205 Alewife Brook Parkway
Cambridge, Massachusetts 02138

EPA Contract No. 68-03-3092

Project Officers

Edward L. Berg and Robert L. Graves
Quality Assurance Branch
Environmental Monitoring and Support Laboratory
Cincinnati, Ohio 45268

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OHIO 45268

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U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA/600/4-85/070	2.
3. RECIPIENT'S ACCESSION NO. PB86 121704/AS	
4. TITLE AND SUBTITLE EPA Method Study 31: Trace Metals by Atomic Absorption (Furnace Techniques)	5. REPORT DATE October 1985 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) T. R. Copeland and J. P. Maney	8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS ERCO/A Division of ENSECO 205 Alewife Brook Parkway Cambridge, MA 02138	10. PROGRAM ELEMENT NO. CBS D/A, BEBIC 11. CONTRACT/GRANT NO. 68-03-3092
12. SPONSORING AGENCY NAME AND ADDRESS Quality Assurance Branch Environmental Monitoring & Support Branch U.S. Environmental Protection Agency Cincinnati, Ohio 45268	13. TYPE OF REPORT AND PERIOD COVERED Final 12/81-4/84 14. SPONSORING AGENCY CODE EPA-ORD
15. SUPPLEMENTARY NOTES	

16. ABSTRACT

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The study design was based on Youden's non-replicate design for collaborative tests of analytical methods. Three Youden pair samples of the test metals were spiked into six types of test waters and then analyzed. The test waters were three industrial effluents supplied by ERCO and three waters supplied by the subcontractor laboratories (laboratory pure water, finished drinking water, and surface water). The resulting data were statistically analyzed using the computer program entitled "Interlaboratory Method Validation Study" (IMVS).

KEY WORDS AND DOCUMENT ANALYSIS

17. a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group

18. DISTRIBUTION STATEMENT Release to Public	19. SECURITY CLASS *(This Report)* Unclassified	21. NO. OF PAGES 375
	20. SECURITY CLASS *(This page)* Unclassified	22. PRICE

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE

DISCLAIMER

The information in this document has been funded wholly or in part by the United States Environmental Protection Agency under EPA Contract No. 68-03-3092 to Energy Resources Co. Inc. (ERCO). It has been subject to the Agency's peer and administrative review, and it has been approved for publication as an EPA document. Mention of trade names or names of commercially available products does not constitute endorsement or recommendation for use.

FOREWORD

Environmental measurements are required to determine the quality of ambient waters and the character of waste effluents. The Environmental Monitoring and Support Laboratory-Cincinnati conducts research to:

- Develop and evaluate methods to measure the presence and concentration of physical, chemical, and radiological pollutants in water, wastewater, bottom sediments, and solid waste.

- Investigate methods for the concentration, recovery, and identification of viruses, bacteria and other microbiological organisms in water; and to determine the responses of aquatic organisms to water quality.

- Develop and operate an Agency-wide quality assurance program to assure standardization and quality control of systems for monitoring water and wastewater.

- Develop and operate a computerized system for instrument automation leading to improved data collection, analysis, and quality control.

This publication reports the results of U.S. EPA's interlaboratory Method Study 31, conducted to determine the accuracy and precision of graphite furnace atomic absorption methods for the analysis of 18 trace metals.

Federal agencies, states, municipalities, universities, private laboratories and industry should find this study of assistance in monitoring trace metal pollution in the environment.

Robert L. Booth

Robert L. Booth
Director, EMSL-Cincinnati

ABSTRACT

An interlaboratory study in which 10 laboratories participated was conducted to provide precision and accuracy statements for the analysis of 18 metals by graphite furnace atomic absorption spectrometry. Samples were prepared and analyzed using procedures specified in "Methods for Chemical Analysis of Water and Wastes," EPA 600-4/79-020, U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio, March 1979.

The study design was based on Youden's non-replicate design for collaborative tests of analytical methods. Three Youden pair samples of the test metals were spiked into six types of test waters and then analyzed. The test waters were three industrial effluents supplied by ERCO and three waters supplied by the subcontractor laboratories (laboratory pure water, finished drinking water, and surface water). The resulting data were statistically analyzed using the computer program entitled "Interlaboratory Method Validation Study" (IMVS).

This report was submitted in fulfillment of Contract No. 68-03-3092 by ERCO, Inc., Environmental Sciences Division. This report covers a period from December 1981 to April 1984 and work was completed as of April 1984.

ACKNOWLEDGMENT

The authors appreciate the cooperation of all ERCO staff members who participated in this study. The authors acknowledge the sincere efforts of the participating laboratories to provide viable data for this study.

Gratitude is also expressed to the industries for their interest in the study and for their willingness to provide the wastewater effluents. Lastly, we thank Mr. Edward L. berg and Robert Graves, EPA Project Officers, and Theodore Martin of EMSL (Cincinnati) whose guidance and intense interest in the study contributed to the successful completion of a difficult task.

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SECTION 1

INTRODUCTION

The Safe Drinking Water Act (SDWA) and the National Pollutant Discharge Elimination System (NPDES) require that waters and waste be analyzed to determine their chemical content. The EPA was given a mandate to prepare methods which would be approved for the analysis of parameters of concern listed by these laws and resulting regulations.

The EPA staff of the Environmental Monitoring and Support Laboratory of Cincinnati, Ohio, provided the procedures for monitoring metal parameters in wastes and waters in the document entitled, "Methods for Chemical Analysis of Water and Wastes"(1). The second edition of this manual, which was published in March 1979, added atomic absorption furnace methods to quantitate lower levels of metal parameters than those determinable by the flame atomic absorption methods specified in the first edition.

Energy Resources Co. Inc. (ERCO) was contracted by EPA to conduct a method study to define the accuracy and precision of the atomic absorption furnace procedure for the following 18 trace metals:

Aluminum	(Method 202.2)	Iron	(Method 236.2)
Antimony	(Method 204.2)	Lead	(Method 239.2)
Arsenic	(Method 206.2)	Manganese	(Method 243.2)

Barium	(Method 208.2)	Nickel	(Method 249.2)
Beryllium	(Method 210.2)	Selenium	(Method 270.2)
Cadmium	(Method 213.2)	Silver	(Method 272.2)
Chromium	(Method 218.2)	Thallium	(Method 279.2)
Cobalt	(Method 219.2)	Vanadium	(Method 286.2)
Copper	(method 220.2)	Zinc	(Method 289.2)

Ten laboratories were selected by ERCO for participating in the method study following their successful analysis of performance evaluation samples. These laboratories then collected drinking, surface, and laboratory pure waters while ERCO supplied them with three different types of industrial effluents. These waters and effluents were analyzed to determine background levels of the elements of interest and subsequently specified volumes of unknown metal concentrates were added and the samples reanalyzed. The added level of each metal was determined by difference.

Youden's non-replicate (2) collaborative test design was applied to 10 participating laboratories. Formal statistical techniques compatible with the Youden design were used to identify outliers, estimate the method's accuracy and precision and test for the effect of water type. The formal statistical analyses were carried out using U.S. EPA's IMVS computer program (3).

SECTION 2

CONCLUSIONS AND RECOMMENDATIONS

The primary objective of the study was to define the precision and accuracy of furnace atomic absorption procedures for the analysis of 18 metals. The IMVS program regresses overall precision and single analyst precision against the mean recovery of a particular element in a given water type and regresses accuracy against the true concentration. The linear regression equations best approximating these relationships are presented in Table 1. These equations may be used to predict the precision and accuracy of the methods at any concentration in the ranges investigated in this study. Since the background levels of the metals analyzed varied among the six waters investigated, the applicable ranges over which the equations are valid also vary. The exact ranges over which the equations are valid are also presented in Table 1.

Other conclusions which may be drawn from this study are as follow:

- Statistically significant effects across some water types were found for As, Be, Cu, Fe, Mn, Ni, Se, Ag, Tl and Zn; however the effect was not considered of practical importance for Cu, Fe, Mn, and Zn.

- Ag, Be, Cd and Mn analyses near the recommended method detection limits (1) were highly erratic and several laboratories could not achieve the detection limits.

TABLE 1.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

REGRESSION EQUATIONS FOR ACCURACY AND PRECISION FOR COMPOUND 1

WATER TYPE	ALUMINUM
APPLICABLE CONC. RANGE	(28.00 - 125.00) ug/L
LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.23X + 6.45
OVERALL PRECISION	S = 0.42X + 5.83
ACCURACY	X = 0.70C +32.36
DRINKING WATER	
SINGLE-ANALYST PRECISION	SR = 0.12X +21.97
OVERALL PRECISION	S = 0.25X +14.45
ACCURACY	X = 1.10C +39.21
SURFACE WATER	
SINGLE-ANALYST PRECISION	SR = 0.33X + 5.29
OVERALL PRECISION	S = 0.80X - 0.27
ACCURACY	X =-0.34C + 33.60

WATER TYPE	ALUMINUM
APPLICABLE CONC. RANGE	(26.80 - 120.00) ug/L
LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.23X + 6.21
OVERALL PRECISION	S = 0.42X + 5.80
ACCURACY	X = 0.70C +31.13
EFFLUENT 3	
SINGLE-ANALYST PRECISION	SR = 0.24X + 3.18
OVERALL PRECISION	S = 0.14X +26.59
ACCURACY	X = 1.03C +32.88

WATER TYPE	ALUMINUM
APPLICABLE CONC. RANGE	(11.00 - 58.30) mg/L
LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.36X - 2.87
OVERALL PRECISION	S = 0.39X - 2.27
ACCURACY	X = 0.85C + 1.87
EFFLUENT 1	
SINGLE-ANALYST PRECISION	SR = 0.16X + 0.88
OVERALL PRECISION	S = 0.26X + 2.24
ACCURACY	X = 1.12C - 2.89

WATER TYPE	ALUMINUM
APPLICABLE CONC. RANGE	(0.46 - 2.18) mg/L
LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.39X - 0.14
OVERALL PRECISION	S = 0.39X - 0.09
ACCURACY	X = 0.85C + 0.08
EFFLUENT 2	
SINGLE-ANALYST PRECISION	SR =-0.04X + 0.16
OVERALL PRECISION	S = 0.07X + 0.18
ACCURACY	X = 0.85C + 0.12

X = MEAN RECOVERY
C = TRUE VALUE FOR THE CONCENTRATION

TABLE 1 (continued)

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

REGRESSION EQUATIONS FOR ACCURACY AND PRECISION FOR COMPOUND 1

WATER TYPE	ANTIMONY
APPLICABLE CONC. RANGE	(10.50 - 230.00) ug/L
LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.14X + 1.09
OVERALL PRECISION	S = 0.40X + 0.88
ACCURACY	X = 0.65C + 0.56
EFFLUENT 1	
SINGLE-ANALYST PRECISION	SR = 0.24X - 0.50
OVERALL PRECISION	S = 0.17X + 3.89
ACCURACY	X = 0.88C - 1.28
EFFLUENT 2	
SINGLE-ANALYST PRECISION	SR = 0.12X + 4.23
OVERALL PRECISION	S = 0.09X + 9.56
ACCURACY	X = 0.73C + 5.80
EFFLUENT 3	
SINGLE-ANALYST PRECISION	SR = 0.22X + 0.37
OVERALL PRECISION	S = 0.33X + 0.87
ACCURACY	X = 0.61C + 0.31
APPLICABLE CONC. RANGE	(11.00 - 240.00) ug/L
LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.23X + 0.02
OVERALL PRECISION	S = 0.34X + 0.86
ACCURACY	X = 0.80C - 2.66
DRINKING WATER	
SINGLE-ANALYST PRECISION	SR = 0.21X - 0.14
OVERALL PRECISION	S = 0.18X + 0.73
ACCURACY	X = 0.87C - 2.14
SURFACE WATER	
SINGLE-ANALYST PRECISION	SR = 0.16X + 0.14
OVERALL PRECISION	S = 0.20X + 0.87
ACCURACY	X = 0.81C - 0.97

X = MEAN RECOVERY
C = TRUE VALUE FOR THE CONCENTRATION

TABLE 1 (continued)

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

REGRESSION EQUATIONS FOR ACCURACY AND PRECISION FOR COMPOUND 1

WATER TYPE	ARSENIC	WATER TYPE	ARSENIC
APPLICABLE CONC. RANGE	(9.78 - 227.00) ug/L	APPLICABLE CONC. RANGE	(10.20 - 237.00) ug/L
LAB PURE WATER		LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.08X + 2.82	SINGLE-ANALYST PRECISION	SR = 0.10X + 0.70
OVERALL PRECISION	S = 0.17X + 1.98	OVERALL PRECISION	S = 0.11X + 1.98
ACCURACY	X = 1.02C + 3.30	ACCURACY	X = 0.92C + 0.69
EFFLUENT 1		DRINKING WATER	
SINGLE-ANALYST PRECISION	SR = 0.07X + 5.85	SINGLE-ANALYST PRECISION	SR = 0.06X + 1.96
OVERALL PRECISION	S = 0.15X + 4.01	OVERALL PRECISION	S = 0.12X + 1.49
ACCURACY	X = 1.15C + 8.87	ACCURACY	X = 0.93C + 0.62
EFFLUENT 2		SURFACE WATER	
SINGLE-ANALYST PRECISION	SR = 0.16X + 0.91	SINGLE-ANALYST PRECISION	SR = 0.09X + 0.80
OVERALL PRECISION	S = 0.14X + 3.70	OVERALL PRECISION	S = 0.13X + 2.75
ACCURACY	X = 0.94C - 0.68	ACCURACY	X = 0.91C - 1.29
EFFLUENT 3			
SINGLE-ANALYST PRECISION	SR = 0.07X + 0.53		
OVERALL PRECISION	S = 0.15X + 2.56		
ACCURACY	X = 0.87C - 0.30		

X = MEAN RECOVERY
C = TRUE VALUE FOR THE CONCENTRATION

TABLE 1 (continued)

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

REGRESSION EQUATIONS FOR ACCURACY AND PRECISION FOR COMPOUND 1

WATER TYPE	BARIUM	WATER TYPE	BARIUM
APPLICABLE CONC. RANGE	(56.50 - 418.00) ug/L	APPLICABLE CONC. RANGE	(59.10 - 437.00) ug/L
LAB PURE WATER		LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.12X + 4.80	SINGLE-ANALYST PRECISION	SR = 0.15X - 1.72
OVERALL PRECISION	S = 0.36X - 8.62	OVERALL PRECISION	S = 0.14X +15.63
ACCURACY	X = 0.84C +83.71	ACCURACY	X = 0.84C +30.67
EFFLUENT 1		DRINKING WATER	
SINGLE-ANALYST PRECISION	SR = 0.19X +10.20	SINGLE-ANALYST PRECISION	SR = 0.11X + 2.22
OVERALL PRECISION	S = 0.27X +32.68	OVERALL PRECISION	S = 0.37X -10.56
ACCURACY	X = 0.97C +67.43	ACCURACY	X = 0.92C +36.50
EFFLUENT 2		SURFACE WATER	
SINGLE-ANALYST PRECISION	SR = 0.29X -13.14	SINGLE-ANALYST PRECISION	SR = 0.20X - 0.16
OVERALL PRECISION	S = 0.58X -27.91	OVERALL PRECISION	S = 0.28X + 1.58
ACCURACY	X = 0.84C +42.52	ACCURACY	X = 0.93C +30.17
EFFLUENT 3			
SINGLE-ANALYST PRECISION	SR = 0.69X -39.17		
OVERALL PRECISION	S = 0.34X + 9.88		
ACCURACY	X = 0.24C +65.63		

X = MEAN RECOVERY
C = TRUE VALUE FOR THE CONCENTRATION

TABLE 1 (continued)

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

REGRESSION EQUATIONS FOR ACCURACY AND PRECISION FOR COMPOUND 1

WATER TYPE	BERYLLIUM
APPLICABLE CONC. RANGE	(0.45 - 10.90) ug/L
LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.12X + 0.05
OVERALL PRECISION	S = 0.29X + 0.05
ACCURACY	X = 1.15C - 0.25
EFFLUENT 1	
SINGLE-ANALYST PRECISION	SR = 0.07X + 0.10
OVERALL PRECISION	S = 0.19X + 0.20
ACCURACY	X = 0.92C + 0.11
EFFLUENT 2	
SINGLE-ANALYST PRECISION	SR = 0.12X - 0.05
OVERALL PRECISION	S = 0.07X + 0.19
ACCURACY	X = 1.08C + 0.01
EFFLUENT 3	
SINGLE-ANALYST PRECISION	SR = 0.13X - 0.00
OVERALL PRECISION	S = 0.20X + 0.08
ACCURACY	X = 0.92C - 0.03

WATER TYPE	BERYLLIUM
APPLICABLE CONC. RANGE	(0.47 - 11.40) ug/L
LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.10X + 0.08
OVERALL PRECISION	S = 0.11X + 0.18
ACCURACY	X = 0.98C - 0.05
DRINKING WATER	
SINGLE-ANALYST PRECISION	SR = 0.03X + 0.11
OVERALL PRECISION	S = 0.14X + 0.07
ACCURACY	X = 1.01C - 0.07
SURFACE WATER	
SINGLE-ANALYST PRECISION	SR = 0.10X + 0.02
OVERALL PRECISION	S = 0.29X - 0.08
ACCURACY	X = 0.90C + 0.10

X = MEAN RECOVERY
C = TRUE VALUE FOR THE CONCENTRATION

TABLE 1 (continued)

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

REGRESSION EQUATIONS FOR ACCURACY AND PRECISION FOR COMPOUND 1

WATER TYPE	CADMIUM	WATER TYPE	CADMIUM
APPLICABLE CONC. RANGE	(0.43 - 12.00) ug/L	APPLICABLE CONC. RANGE	(0.45 - 12.50) ug/L
LAB PURE WATER		LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.09X + 0.25	SINGLE-ANALYST PRECISION	SR = 0.10X + 0.05
OVERALL PRECISION	S = 0.17X + 0.20	OVERALL PRECISION	S = 0.27X - 0.05
ACCURACY	X = 1.02C + 0.24	ACCURACY	X = 0.95C + 0.09
EFFLUENT 1		DRINKING WATER	
SINGLE-ANALYST PRECISION	SR = 0.14X + 0.42	SINGLE-ANALYST PRECISION	SR = 0.17X + 0.11
OVERALL PRECISION	S = 0.32X + 0.15	OVERALL PRECISION	S = 0.26X + 0.10
ACCURACY	X = 0.75C + 0.39	ACCURACY	X = 0.92C + 0.24
EFFLUENT 2		SURFACE WATER	
SINGLE-ANALYST PRECISION	SR = 0.12X + 0.09	SINGLE-ANALYST PRECISION	SR = 0.22X - 0.13
OVERALL PRECISION	S = 0.23X + 0.07	OVERALL PRECISION	S = 0.38X + 0.10
ACCURACY	X = 0.81C + 0.15	ACCURACY	X = 1.04C + 0.15
EFFLUENT 3			
SINGLE-ANALYST PRECISION	SR = 0.15X + 0.04		
OVERALL PRECISION	S = 0.27X + 0.14		
ACCURACY	X = 0.96C + 0.10		

X = MEAN RECOVERY
C = TRUE VALUE FOR THE CONCENTRATION

TABLE 1 (continued)

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

REGRESSION EQUATIONS FOR ACCURACY AND PRECISION FOR COMPOUND 1

WATER TYPE	CHROMIUM	WATER TYPE	CHROMIUM
APPLICABLE CONC. RANGE	(9.87 - 236.00) ug/L	APPLICABLE CONC. RANGE	(10.30 - 246.00) ug/L
LAB PURE WATER		LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.18X + 0.73	SINGLE-ANALYST PRECISION	SR = 0.12X - 0.41
OVERALL PRECISION	S = 0.20X + 1.14	OVERALL PRECISION	S = 0.14X + 0.35
ACCURACY	X = 0.89C + 0.11	ACCURACY	X = 0.94C + 0.40
EFFLUENT 1		DRINKING WATER	
SINGLE-ANALYST PRECISION	SR = 0.14X + 0.88	SINGLE-ANALYST PRECISION	SR = 0.06X + 2.73
OVERALL PRECISION	S = 0.21X + 3.87	OVERALL PRECISION	S = 0.12X + 4.14
ACCURACY	X = 0.87C + 1.09	ACCURACY	X = 1.00C + 0.89
EFFLUENT 2		SURFACE WATER	
SINGLE-ANALYST PRECISION	SR = 0.17X - 0.32	SINGLE-ANALYST PRECISION	SR = 0.12X - 0.12
OVERALL PRECISION	S = 0.14X + 2.55	OVERALL PRECISION	S = 0.26X - 0.04
ACCURACY	X = 0.95C + 1.03	ACCURACY	X = 0.91C + 0.47
EFFLUENT 3			
SINGLE-ANALYST PRECISION	SR = 0.08X + 0.28		
OVERALL PRECISION	S = 0.22X + 0.41		
ACCURACY	X = 0.92C - 0.68		

X = MEAN RECOVERY
C = TRUE VALUE FOR THE CONCENTRATION

TABLE 1 (continued)

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

REGRESSION EQUATIONS FOR ACCURACY AND PRECISION FOR COMPOUND 1

WATER TYPE	COBALT
APPLICABLE CONC. RANGE	(29.70 - 420.00) ug/L
LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.09X + 0.50
OVERALL PRECISION	S = 0.25X - 2.99
ACCURACY	X = 0.88C + 1.36
DRINKING WATER	
SINGLE-ANALYST PRECISION	SR = 0.12X + 1.60
OVERALL PRECISION	S = 0.23X + 1.24
ACCURACY	X = 0.92C + 0.44
SURFACE WATER	
SINGLE-ANALYST PRECISION	SR = 0.14X - 1.00
OVERALL PRECISION	S = 0.18X - 0.14
ACCURACY	X = 0.92C + 2.01

WATER TYPE	COBALT
APPLICABLE CONC. RANGE	(24.80 - 407.00) ug/L
LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.11X + 0.02
OVERALL PRECISION	S = 0.25X - 2.69
ACCURACY	X = 0.89C + 1.11
EFFLUENT 1	
SINGLE-ANALYST PRECISION	SR = 0.16X + 0.58
OVERALL PRECISION	S = 0.20X - 0.89
ACCURACY	X = 0.88C + 4.50

WATER TYPE	COBALT
APPLICABLE CONC. RANGE	(21.10 - 461.00) ug/L
LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.09X + 0.03
OVERALL PRECISION	S = 0.25X - 1.99
ACCURACY	X = 0.89C + 0.29
EFFLUENT 2	
SINGLE-ANALYST PRECISION	SR = 0.09X + 3.21
OVERALL PRECISION	S = 0.13X + 1.76
ACCURACY	X = 0.95C + 0.43

WATER TYPE	COBALT
APPLICABLE CONC. RANGE	(29.30 - 435.00) ug/L
LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.09X + 0.16
OVERALL PRECISION	S = 0.25X - 3.31
ACCURACY	X = 0.88C + 1.32
EFFLUENT 3	
SINGLE-ANALYST PRECISION	SR = 0.06X + 2.06
OVERALL PRECISION	S = 0.15X + 1.28
ACCURACY	X = 0.82C + 1.43

X = MEAN RECOVERY
C = TRUE VALUE FOR THE CONCENTRATION

TABLE 1 (continued)

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

REGRESSION EQUATIONS FOR ACCURACY AND PRECISION FOR COMPOUND 1

WATER TYPE	COPPER
APPLICABLE CONC. RANGE	(10.10 - 234.00) ug/L
LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.07X + 4.37
OVERALL PRECISION	S = 0.11X + 4.97
ACCURACY	X = 0.92C - 0.81
EFFLUENT 1	
SINGLE-ANALYST PRECISION	SR = 0.22X - 0.44
OVERALL PRECISION	S = 0.21X + 1.21
ACCURACY	X = 0.96C - 0.10
EFFLUENT 3	
SINGLE-ANALYST PRECISION	SR = 0.13X + 1.95
OVERALL PRECISION	S = 0.29X + 4.96
ACCURACY	X = 0.81C + 0.42

WATER TYPE	COPPER
APPLICABLE CONC. RANGE	(0.30 - 1.67) mg/L
LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.13X - 0.02
OVERALL PRECISION	S = 0.13X - 0.00
ACCURACY	X = 0.93C + 0.01
EFFLUENT 2	
SINGLE-ANALYST PRECISION	SR = 0.05X + 0.02
OVERALL PRECISION	S = 0.13X + 0.01
ACCURACY	X = 1.02C - 0.07

WATER TYPE	COPPER
APPLICABLE CONC. RANGE	(10.60 - 245.00) ug/L
LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.22X - 0.46
OVERALL PRECISION	S = 0.21X + 1.29
ACCURACY	X = 0.96C - 0.11
DRINKING WATER	
SINGLE-ANALYST PRECISION	SR = 0.15X + 2.63
OVERALL PRECISION	S = 0.34X + 3.39
ACCURACY	X = 0.91C + 6.09
SURFACE WATER	
SINGLE-ANALYST PRECISION	SR = 0.06X + 1.81
OVERALL PRECISION	S = 0.18X + 1.44
ACCURACY	X = 1.00C - 0.26

X = MEAN RECOVERY
C = TRUE VALUE FOR THE CONCENTRATION

TABLE 1 (continued)

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

REGRESSION EQUATIONS FOR ACCURACY AND PRECISION FOR COMPOUND 1

WATER TYPE	IRON	WATER TYPE	IRON
APPLICABLE CONC. RANGE	(26.10 - 455.00) ug/L	APPLICABLE CONC. RANGE	(25.00 - 435.00) ug/L
LAB PURE WATER		LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.30X +26.13	SINGLE-ANALYST PRECISION	SR = 0.30X +25.23
OVERALL PRECISION	S = 0.35X +13.23	OVERALL PRECISION	S = 0.35X +12.73
ACCURACY	X = 1.40C +11.73	ACCURACY	X = 1.41C +11.24
DRINKING WATER		EFFLUENT 3	
SINGLE-ANALYST PRECISION	SR = 0.30X + 1.06	SINGLE-ANALYST PRECISION	SR = 0.23X +16.21
OVERALL PRECISION	S = 0.36X + 9.15	OVERALL PRECISION	S = 0.31X +31.14
ACCURACY	X = 1.20C +10.35	ACCURACY	X = 1.09C +37.18
SURFACE WATER			
SINGLE-ANALYST PRECISION	SR = 0.35X - 3.95		
OVERALL PRECISION	S = 0.34X +37.42		
ACCURACY	X = 1.10C +96.38		

WATER TYPE	IRON	WATER TYPE	IRON
APPLICABLE CONC. RANGE	(1.03 - 5.59) mg/L	APPLICABLE CONC. RANGE	(0.37 - 2.61)mg/L
LAB PURE WATER		LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.04X + 0.13	SINGLE-ANALYST PRECISION	SR = 0.06X + 0.03
OVERALL PRECISION	S = 0.05X + 0.27	OVERALL PRECISION	S = 0.07X + 0.08
ACCURACY	X = 1.01C + 0.07	ACCURACY	X = 1.42C - 0.17
EFFLUENT 1		EFFLUENT 2	
SINGLE-ANALYST PRECISION	SR = 0.28X + 0.04	SINGLE-ANALYST PRECISION	SR = 0.18X - 0.03
OVERALL PRECISION	S = 0.41X - 0.13	OVERALL PRECISION	S = 0.22X - 0.01
ACCURACY	X = 1.16C - 0.25	ACCURACY	X = 1.00C + 0.04

X = MEAN RECOVERY
C = TRUE VALUE FOR THE CONCENTRATION

TABLE 1 (continued)

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

REGRESSION EQUATIONS FOR ACCURACY AND PRECISION FOR COMPOUND 1

WATER TYPE	LEAD
APPLICABLE CONC. RANGE	(10.40 - 243.00) ug/L
LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.17X - 0.88
OVERALL PRECISION	S = 0.17X + 1.36
ACCURACY	X = 1.06C - 2.26
EFFLUENT 1	
SINGLE-ANALYST PRECISION	SR = 0.22X - 0.14
OVERALL PRECISION	S = 0.23X - 0.06
ACCURACY	X = 0.81C + 2.05
EFFLUENT 2	
SINGLE-ANALYST PRECISION	SR = 0.14X + 1.00
OVERALL PRECISION	S = 0.22X + 1.40
ACCURACY	X = 0.86C - 2.12
EFFLUENT 3	
SINGLE-ANALYST PRECISION	SR = 0.22X + 1.48
OVERALL PRECISION	S = 0.34X + 1.86
ACCURACY	X = 0.70C + 1.63

WATER TYPE	LEAD
APPLICABLE CONC. RANGE	(10.90 - 254.00) ug/L
LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.20X + 0.42
OVERALL PRECISION	S = 0.28X - 0.66
ACCURACY	X = 0.83C + 1.35
DRINKING WATER	
SINGLE-ANALYST PRECISION	SR = 0.07X + 1.39
OVERALL PRECISION	S = 0.21X + 2.56
ACCURACY	X = 0.85C + 0.50
SURFACE WATER	
SINGLE-ANALYST PRECISION	SR = 0.19X + 0.11
OVERALL PRECISION	S = 0.18X + 1.73
ACCURACY	X = 0.92C - 0.96

X = MEAN RECOVERY
C = TRUE VALUE FOR THE CONCENTRATION

TABLE 1 (continued)

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

REGRESSION EQUATIONS FOR ACCURACY AND PRECISION FOR COMPOUND 1

WATER TYPE	MANGANESE	WATER TYPE	MANGANESE
APPLICABLE CONC. RANGE	(0.44 - 14.80) ug/L	APPLICABLE CONC. RANGE	(91.00 - 484.00) ug/L
LAB PURE WATER		LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.27X + 0.31	SINGLE-ANALYST PRECISION	SR = 0.03X +11.34
OVERALL PRECISION	S = 0.44X + 0.48	OVERALL PRECISION	S = 0.05X +11.20
ACCURACY	X = 1.00C + 1.46	ACCURACY	X = 0.55C X12.98
DRINKING WATER		EFFLUENT 1	
SINGLE-ANALYST PRECISION	SR = 0.16X + 0.51	SINGLE-ANALYST PRECISION	SR = 0.04X +40.27
OVERALL PRECISION	S = 0.38X + 0.52	OVERALL PRECISION	S = 0.11X +32.01
ACCURACY	X = 0.90C + 1.38	ACCURACY	X = 0.97C - 6.66
SURFACE WATER			
SINGLE-ANALYST PRECISION			
OVERALL PRECISION			
ACCURACY			

WATER TYPE	MANGANESE	WATER TYPE	MANGANESE
APPLICABLE CONC. RANGE	(111.00 - 666.00) ug/L	APPLICABLE CONC. RANGE	(0.42 - 14.20) ug/L
LAB PURE WATER		LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.05X + 8.13	SINGLE-ANALYST PRECISION	SR = 0.27X + 0.31
OVERALL PRECISION	S = 0.07X + 9.19	OVERALL PRECISION	S = 0.43X + 0.47
ACCURACY	X = 0.93C + 9.38	ACCURACY	X = 1.00C + 1.40
EFFLUENT 2		EFFLUENT 3	
SINGLE-ANALYST PRECISION	SR = 0.26X + 3.47	SINGLE-ANALYST PRECISION	SR = 0.23X + 0.52
OVERALL PRECISION	S = 0.32X - 6.30	OVERALL PRECISION	S = 0.48X - 0.28
ACCURACY	X = 0.78C - 8.22	ACCURACY	X = 0.46C + 2.56

X = MEAN RECOVERY
C = TRUE VALUE FOR THE CONCENTRATION

TABLE 1 (continued)

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

REGRESSION EQUATIONS FOR ACCURACY AND PRECISION FOR COMPOUND 1

WATER TYPE	NICKEL	WATER TYPE	NICKEL
APPLICABLE CONC. RANGE	(26.20 - 461.00) ug/L	APPLICABLE CONC. RANGE	(27.40 - 482.00) ug/L
LAB PURE WATER		LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.17X + 0.34	SINGLE-ANALYST PRECISION	SR = 0.21X - 2.45
OVERALL PRECISION	S = 0.26X + 1.89	OVERALL PRECISION	S = 0.23X + 1.98
ACCURACY	X = 0.84C + 6.46	ACCURACY	X = 0.93C - 2.02
EFFLUENT 1		DRINKING WATER	
SINGLE-ANALYST PRECISION	SR = 0.10X + 3.46	SINGLE-ANALYST PRECISION	SR = 0.12X + 4.43
OVERALL PRECISION	S = 0.16X + 4.72	OVERALL PRECISION	S = 0.27X + 2.20
ACCURACY	X = 0.67C +10.56	ACCURACY	X = 0.81C + 0.75
EFFLUENT 2		SURFACE WATER	
SINGLE-ANALYST PRECISION	SR = 0.13X + 2.39	SINGLE-ANALYST PRECISION	SR = 0.10X + 4.38
OVERALL PRECISION	S = 0.24X + 5.60	OVERALL PRECISION	S = 0.16X + 9.37
ACCURACY	X = 0.85C - 4.74	ACCURACY	X = 0.81C + 2.47
EFFLUENT 3			
SINGLE-ANALYST PRECISION	SR = 0.04X + 1.88		
OVERALL PRECISION	S = 0.18X + 9.11		
ACCURACY	X = 0.84C - 9.99		

X = MEAN RECOVERY
C = TRUE VALUE FOR THE CONCENTRATION

TABLE 1 (continued)

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

REGRESSION EQUATIONS FOR ACCURACY AND PRECISION FOR COMPOUND 1 .

WATER TYPE	SELENIUM
APPLICABLE CONC. RANGE	(10.00 - 235.00) ug/L
LAB PURE WATER SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	 SR = 0.06X + 0.65 S = 0.17X + 0.14 X = 0.93C - 0.20
EFFLUENT 1 SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	 SR = 0.05X + 3.19 S = 0.19X + 1.76 X = 0.88C - 2.45
EFFLUENT 2 SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	 SR = 0.11X + 3.14 S = 0.19X + 2.78 X = 1.11C - 2.78
EFFLUENT 3 SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	 SR = 0.17X + 0.20 S = 0.40X + 2.55 X = 0.84C - 2.14

WATER TYPE	SELENIUM
APPLICABLE CONC. RANGE	(10.50 - 246.00) ug/L
LAB PURE WATER SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	 SR = 0.10X + 0.50 S = 0.14X + 2.18 X = 0.98C + 1.28
DRINKING WATER SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	 SR = 0.05X + 2.23 S = 0.16X + 3.16 X = 1.07C + 0.19
SURFACE WATER SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	 SR = 0.15X + 0.25 S = 0.17X + 1.64 X = 1.00C - 0.66

X = MEAN RECOVERY
C = TRUE VALUE FOR THE CONCENTRATION

TABLE 1 (continued)

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

REGRESSION EQUATIONS FOR ACCURACY AND PRECISION FOR COMPOUND 1

WATER TYPE	SILVER
APPLICABLE CONC. RANGE	(8.48 - 56.50) ug/L
LAB PURE WATER SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	SR = 0.19X - 0.95 S = 0.17X + 0.35 X = 0.79C + 2.78
EFFLUENT 1 SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	SR = 0.06X + 0.78 S = 0.28X - 1.05 X = 0.90C + 0.96
EFFLUENT 2 SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	SR = 0.28X + 1.11 S = 0.65X + 0.26 X = 0.49C + 0.03
EFFLUENT 3 SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	SR = 0.34X - 2.10 S = 0.38X - 1.06 X = 0.70C + 4.27

WATER TYPE	SILVER
APPLICABLE CONC. RANGE	(0.45 - 13.60) ug/L
LAB PURE WATER SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	SR = 0.15X + 0.03 S = 0.18X + 0.15 X = 0.96C + 0.17
DRINKING WATER SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	SR = -0.02X + 0.77 S = 0.20X + 0.17 X = 0.82C + 0.81
SURFACE WATER SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	SR = 0.10X - 0.07 S = 0.56X + 0.06 X = 0.87C + 2.46

X = MEAN RECOVERY
C = TRUE VALUE FOR THE CONCENTRATION

TABLE 1 (continued)

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

REGRESSION EQUATIONS FOR ACCURACY AND PRECISION FOR COMPOUND 1

WATER TYPE	THALLIUM	WATER TYPE	THALLIUM
APPLICABLE CONC. RANGE	(10.00 - 241.00) ug/L	APPLICABLE CONC. RANGE	(10.50 - 252.00) ug/L
LAB PURE WATER		LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.15X + 0.03	SINGLE-ANALYST PRECISION	SR = 0.06X + 0.41
OVERALL PRECISION	S = 0.12X + 0.96	OVERALL PRECISION	S = 0.11X + 0.13
ACCURACY	X = 0.87C - 1.24	ACCURACY	X = 0.88C - 0.10
EFFLUENT 1		DRINKING WATER	
SINGLE-ANALYST PRECISION	SR = 0.09X + 0.41	SINGLE-ANALYST PRECISION	SR = 0.09X - 0.29
OVERALL PRECISION	S = 0.30X - 0.04	OVERALL PRECISION	S = 0.26X - 1.14
ACCURACY	X = 0.76C - 1.12	ACCURACY	X = 0.89C - 0.89
EFFLUENT 2		SURFACE WATER	
SINGLE-ANALYST PRECISION	SR = 0.16X - 0.20	SINGLE-ANALYST PRECISION	SR = 0.10X + 0.02
OVERALL PRECISION	S = 0.14X + 1.58	OVERALL PRECISION	S = 0.25X - 0.14
ACCURACY	X = 0.62C - 1.06	ACCURACY	X = 0.84C - 1.15
EFFLUENT 3			
SINGLE-ANALYST PRECISION	SR = 0.06X + 0.00		
OVERALL PRECISION	S = 0.19X + 0.33		
ACCURACY	X = 0.81C - 1.70		

X = MEAN RECOVERY
C = TRUE VALUE FOR THE CONCENTRATION

TABLE 1 (continued)

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

REGRESSION EQUATIONS FOR ACCURACY AND PRECISION FOR COMPOUND 1

WATER TYPE	VANADIUM
APPLICABLE CONC. RANGE	(151.00 - 982.00) ug/L
LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.12X + 2.14
OVERALL PRECISION	S = 0.53X -44.69
ACCURACY	X = 0.75C +26.06
DRINKING WATER	
SINGLE-ANALYST PRECISION	SR = 0.04X +21.95
OVERALL PRECISION	S = 0.18X +14.92
ACCURACY	X = 1.00C -14.73
SURFACE WATER	
SINGLE-ANALYST PRECISION	SR = 0.15X - 5.47
OVERALL PRECISION	S = 0.15X + 0.56
ACCURACY	X = 0.96C -11.91

WATER TYPE	VANADIUM
APPLICABLE CONC. RANGE	(144.00 - 939.00) ug/L
LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.12X + 1.96
OVERALL PRECISION	S = 0.53X -42.61
ACCURACY	X = 0.75C +25.26
EFFLUENT 1	
SINGLE-ANALYST PRECISION	SR = 0.04X +19.60
OVERALL PRECISION	S = 0.24X + 4.39
ACCURACY	X = 1.05C - 7.45
EFFLUENT 2	
SINGLE-ANALYST PRECISION	SR = 0.13X +14.33
OVERALL PRECISION	S = 0.11X +19.77
ACCURACY	X = 0.94C -17.68

WATER TYPE	VANADIUM
APPLICARLE CONC. RANGE	(1.36 - 6.03) mg/L
LAB PURE WATER	
SINGLE-ANALYST PRECISION	SR = 0.05X + 0.01
OVERALL PRECISION	S = 0.11X - 0.01
ACCURACY	X = 0.96C + 0.04
EFFLUENT 3	
SINGLE-ANALYST PRECISION	SR = 0.12X - 0.04
OVERALL PRECISION	S = 0.21X - 0.13
ACCURACY	X = 0.99C - 0.18

X = MEAN RECOVERY
C = TRUE VALUE FOR THE CONCENTRATION

TABLE 1 (continued)

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

REGRESSION EQUATIONS FOR ACCURACY AND PRECISION FOR COMPOUND 1 - 1

WATER TYPE	ZINC
APPLICABLE CONC. RANGE	(0.54 - 17.40) ug/L
LAB PURE WATER SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	 SR = 0.56X - 1.19 S = 1.03X - 1.03 X = 2.93C + 1.02
DRINKING WATER SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	 SR = 0.31X + 6.80 S = 0.99X + 0.69 X = 1.29C +14.50
SURFACE WATER SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	 SR = 0.59X - 5.51 S = 1.06X - 0.04 X = 2.43C + 7.16

WATER TYPE	ZINC
APPLICABLE CONC. RANGE	(1.31 - 6.41) mg/L
LAB PURE WATER SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	 SR = 0.24X + 0.04 S = 0.30X + 0.11 X = 1.18C - 0.31
EFFLUENT 1 SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	 SR = 0.35X + 0.19 S = 0.69X + 0.10 X = 0.42C + 0.84

WATER TYPE	ZINC
APPLICABLE CONC. RANGE	(24.60 - 189.00) ug/L
LAB PURE WATER SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	 SR = 0.24X + 1.21 S = 0.31X + 1.45 X = 1.11C - 2.76
EFFLUENT 2 SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	 SR = 0.86X -19.95 S = 0.77X - 3.46 X = 1.04C + 9.58

WATER TYPE	ZINC
APPLICABLE CONC. RANGE	(0.51 - 16.70) ug/L
LAB PURE WATER SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	 SR = 0.56X - 1.04 S = 1.00X - 0.63 X = 2.93C + 0.86
EFFLUENT 3 SINGLE-ANALYST PRECISION OVERALL PRECISION ACCURACY	 S = 1.27X -11.00 X = 8.83C +54.05

X = MEAN RECOVERY
C = TRUE VALUE FOR THE CONCENTRATION

- Zn, Al and Fe analyses were erratic with a high percentage of outliers at all concentrations due to contamination. This is most obvious in samples with low background concentrations (the waters as opposed to the industrial effluents), but many data were rejected in all samples for these elements.

- On average 23% of the data were rejected. For four of the six samples, zinc had the highest percentage of data rejected.

- For all six samples, more data were rejected for the low spiking concentrations than for the high spiking concentrations.

- For a single element in a single sample, the worst performer was Mn in surface water where all the data were rejected for one spiking level, again reflecting that for this element the method detection limits (1) cannot be achieved.

Recommendations for future research in this area are as follow:

- Surface and drinking water samples should be supplied to the participating laboratories to assure uniformity of the matrix elements.

- The laboratories' method detection limits (MDLs) should be reassessed since some were unable to obtain acceptable accuracy and precision near the recommended MDL's.

- The type of graphite used and parameters such as background correction, sheath gas, etc., should be specified so that instrumental effects may be separated from matrix or method effects.

SECTION 3

DESCRIPTION OF STUDY

The objective of this study was to define the precision and accuracy of atomic absorption furnace procedures for analysis of 18 metals in three raw wastewater effluents generated by regulated industries, as well as in samples of typical surface, drinking, and laboratory-pure water supplied by ten subcontractor laboratories. Samples were prepared and analyzed for total metals according to atomic absorption furnace methods specified by the U.S. EPA (1). The design of the interlaboratory method study was based on the specific requirements of the Statement of Work, Exhibit A contained in RFP CI-81-0270, as well as precedents set by previous EPA-conducted interlaboratory evaluation studies (3) and the recommendations of Youden (2).

PRELIMINARY SCREENING OF POTENTIAL PARTICIPATING LABORATORIES

An EPA-supplied list of laboratories and previous ERCO experience were used to solicit interested laboratories. Selection of laboratories during the initial screening was based on prior experience of the laboratory in graphite furnace analysis, assurance of adequate facilities, instrumentation, and personnel to complete the required analysis within 45 days of sample receipt, and fixed price cost estimates for the required analyses. Based on

these criteria, ERCO selected the 10 lowest bidders for participation in the second phase (a performance evaluation study) of the selection process. Two other laboratories were selected as backup subcontractors pending the outcome of the performance evaluation study. The names of the 10 laboratories selected for the performance evaluation study were submitted to EPA for approval prior to notification.

Performance Evaluation Study for Participating Laboratories

The final phase of subcontractor laboratory selection included a performance evaluation study conducted by ERCO. Each of the 10 laboratories selected during the initial screening was required to analyze two ERCO-supplied test samples at their own expense. Potential subcontractors were given 20 days from sample receipt to complete the analyses and forward the results to ERCO. Results of the laboratory analyses of the performance evaluation samples were compared to the 95% confidence intervals for the mean values for each element. Analyses falling outside the 95% confidence interval were judged unacceptable and analysis of an additional test sample was required. Failure to achieve acceptable results on the second test sample disqualified the laboratory from participation in the study.

One laboratory failed to produce acceptable results on a second attempt and a substitute was used. Selection and preparation of the performance evaluation samples and analysis of test results were performed in conjunction with the U.S. EPA Project Officer. The laboratories finally selected for the study are listed in Table 2. The order of appearance in the list has no correlation to the "Laboratory Number" used throughout the report. The final results for the performance evaluation study are compiled in Table 3.

Table 2. LIST OF PARTICIPATING LABORATORIES

Envirodyne Engineers
12161 Lackland Road
St. Louis, Missouri 63141
314-434-6960
Dr. Carol Byington

GCA Corporation
Technology Division
213 Burlington Road
Bedford, Massachusetts 01730
617-275-5444
Dr. Kenneth T. McGregor

PEDCo Environmental Inc.
11499 Chester Road
Cincinnati, Ohio 45246
513-782-4700
Mr. Craig Caldwell

Battelle Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201
614-424-7941
Dr. Marvin Miller

Sverdrup Technology, Inc.
600 William Northern Blvd.
P.O. Box 884
Tullahoma, Tennessee 37388
615-455-6400 ext. 603
Dr. Charlotte Kimbrough

Research Triangle Institute
P.O. Box 12194
Research Triangle Park, North Carolina 27709
919-541-6883
Dr. William F. Gutknecht

The University of Iowa
University Hygiene Laboratory
Des Moines Branch
H.A. Wallace Building
Des Moines, Iowa 50319
515-281-5371
Mr. Lee A. Friell

Radian Corporation
8501 Mo-Pac Blvd.
P.O. Box 9948
Austin, Texas 78766
512-454-4797
Mr. Donnie Heinrich

EAL Corporation
2030 Wright Avenue
Richmond, California 94804
415-235-2633
Mr. Larry E. Penfold

Versar Inc.
6621 Electronic Drive
P.O. Box 1549
Springfield, Virginia 22151
703-750-3000
Mr. William Nivens

Table 3. FINAL RESULTS OF PERFORMANCE EVALUATION STUDY

Sample 1

Laboratory	Elemental Concentrations (ug/L) As	Cd	Cu	Pb	Ni	Se	Tl	V
1	28	3.7	47	47	103	51	23	484
2	37	4.1	47	49	97	56	29	364
3	37	5.3	46	52	95	52	37	456
4	40	4.6	44	34[b]	94	59	31	320
5	48	2.4	32[a]	40	97	61	32	360
6	22	5.0	52	48	93	48	33	330
7	33	3.8	54	52	85	56	21	278
8	42	5.1	49	49	102	52	27	315
9	30	2.7	41	48	70[a]	58	26	136
10	35	4.0	50	55	105	60	30	250
11 (ERCO)	37	3.5	47	57	98	53	35	278
Mean and standard deviation before rejection of outliers	35 ± 7.1	4.0 ± 0.9	46 ± 5.9	48 ± 6.5	94 ± 9.8	55 ± 4.2	29 ± 4.9	325 ± 95
Mean and standard deviation after rejection of outliers	35 ± 7.1	4.0 ± 0.9	48 ± 3.8	48 ± 6.5	97 ± 5.8	55 ± 4.2	29 ± 4.9	325 ± 95
Theoretical Value	42	3.6	45	51	98	48	35	320
% of theoretical	83	111	107	94	99	115	87	102
% relative standard deviation	20	23	8	14	6	8	17	29
Acceptance Limits (mean ± 95% confidence interval)	21-79	2.2-5.8	40-56	35-61	82-106	47-63	19-39	135-515

[a]Outlier
[b]Outside acceptance limits

Table 3. (Continued)

Sample 1

Laboratory	Elemental Concentrations (ug/L) As	Cd	Cu	Pb	Ni	Se	Tl	V
1	21	3.0	52	51	87	43	19	445
2	26	4.5	52	48	84	52	24	368
3	25	5.0	72[a]	57	71	42	26	455
4	32	6.4	62	42	96[b]	54	24	360
5	36	3.8	65	80[a]	84	49	21	310
6	18	5.6	50	59	84	44	30	390
7	28	4.4	55	54	87	51	18	325
8	37	5.6	55	55	89	46	22	350
9	26	3.4	55	58	60[a]	52	21	200[b]
10	40	4.5	55	65	90	50	20	300
11 (ERCO)	30	4.0	53	63	88	48	27	324
Mean and standard deviation before rejection of outliers	29 ± 6.8	4.6 ± 1.0	57 ± 6.7	57 ± 9.9	85 ± 9.1	48 ± 4.0	23 ± 3.7	348 ± 71
Mean and standard deviation after rejection of outliers	29 ± 6.8	4.6 ± 1.0	55 ± 4.7	55 ± 6.9	87 ± 4.2	48 ± 4.0	23 ± 3.7	348 ± 71
Theoretical Value	34	4.4	51	56	86	44	28	359
% of theoretical	85	105	108	98	101	109	82	97
% relative standard deviation	23	22	9	13	5	8	16	20
Acceptance Limits (mean ± 95% confidence interval)	15-43	2.6-6.6	44-66	41-69	79-95	40-56	16-30	206-490

[a]Outlier
[b]Outside acceptance limits

EQUIPMENT AND METHODS USED IN THE STUDY

The methods utilized in the study were all U.S. EPA (1) approved graphite furnace methods and are listed by method number in the Introduction of this report. These methods allow some latitude as to what type of instrument or type of graphite is used. The instrumentation and graphite types are listed by laboratory number in Table 4.

EFFLUENTS AND CONCENTRATION LEVELS UTILIZED IN THE INTERLABORATORY METHOD STUDY

The initial consideration for design of the study was to select suitable industrial wastewater effluents for analysis. ERCO applied a number of criteria for selection of the effluents: (1) the effluent must be from an industry regulated for trace metals; (2) the effluents must represent an analytical challenge; (3) at least one effluent must be high in suspended solids; (4) concentration levels of the metals of interest must be suitable for graphite furnace analysis; (5) a previous analytical history should be available to provide a basis for determining likely spike levels; and (6) sufficient quantities of effluent must be readily obtainable. Based on these criteria, ERCO selected effluents from three primary industries (paper and pulp, photographic, and steam and electric) as the wastewater matrices for this study.

Previous analyses of effluents from these three industries indicated that each of these wastewaters presented a unique analytical challenge that is widely applicable to other effluent samples. Effluents from the paper and pulp industry are high in dissolved and suspended solids and contain substantial amounts of potential interferents (alkali and alkaline earth metals and anions such as

Table 4. INSTRUMENTATION USED

Laboratory Number	AAS*	Furnace	Graphite
1.	IL251/257	IL555CTF	All pyrolytic
2.	PE 460 V AA-6	HGA 2100 CRA 63	Pyrolytic for Ba, Ni, V only
3.	PE 305 PE 560	HGA 2000 HGA 2200	Pyrolytic for Ba, Ni, V only
4.	PE 5000	HGA 500	Pyrolytic for Ba, Ni, V only
5.	PE 560 PE 2380	HGA 2200 HGA 2200	All pyrolytic
6.	PE 603	HGA 2100	Pyrolytic for Ba, Ni, V only
7.	PE 306 PE 5000	HGA 2100 HGA 500	Pyrolytic for Ba, Ni, V only
8.	PE 403 PE 503 IL 351	HGA 2200 HGA 2100 IL555CTF	All non-pyrolytic All non-pyrolytic All pyrolytic
9.	PE 373 V 1250	HGA 2200 CRA 63	Pyrolytic for Ba, Ni, V only
10.	PE 2380 PE 703	HGA 400 HGA 2100	Pyrolytic for Ba, Ni, V only

*Abbreviations are as follows: IL=Instrumentation Laboratory; PE=Perkin-Elmer; V=Varian.

chloride or sulfate). Photographic industry wastewaters contain variable amounts of suspended solids, and have considerable amounts of dissolved organic compounds which act as effective chelators in binding metals into non-labile complexes. These sample types require great care in digestion and analysis. Process waters from the steam and electric industry contain small amounts of suspended solids and levels of trace elements near the limit of detection.

Immediately upon contract award, the three selected waste generators were notified and arrangements were made to collect adequate quantities of each effluent. Personnel from ERCO supervised sample collection. Effluent samples were collected in polyethylene-lined, DOT-approved barrels and transported to ERCO's laboratory. At the laboratory, each effluent was transferred to a 300-gallon polyethylene (Nalgene)™ tank and homogenized with a Lightin™ model ND-1 mixer and aerator for 24 hours prior to subsampling. The effluent was then subsampled into acid-rinsed, 1-gallon polyethylene bottles. Subsampling was accomplished using subsurface grab sampler (Fisher #15-437) to collect discrete samples at mid-depth in the tank. The discrete 1-liter samples were transferred sequentially to the individual polyethylene bottles. After each bottle received one aliquot of sample, the tank was resampled and additional aliquots transferred sequentially until all bottles were full. Each sample was then preserved with equal amounts of concentrated Ultrex nitric acid to a pH of <2. The effluents were continuously stirred during subsampling to maximize homogeneity of suspended matter in the effluents. Sufficient effluent was collected to allow preparation of 100 1-gallon aliquots. This provided enough discrete samples to supply each subcontractor laboratory with 4 gallons of effluent and still have a 4-gallon reserve for each, as well as providing 20 additional gallons for homogeneity testing and background analysis.

Following preparation of the effluent samples, 10 1-gallon samples of each effluent were selected at random and analyzed in triplicate by ERCO's Trace Metals Laboratory to determine homogeneity of the sample. The results of this analysis are summarized in Table 5 where the range of analyte values for each effluent are given.

Analysis of each of the ten 1-gallon aliquots was performed in triplicate for all elements of interest using the graphite furnace methods to be used by the collaborating laboratories. A simple analysis of variance can then be used to demonstrate homogeneity of each effluent for each element (4). If the ratio of the between-to-within sample variances is less than the tabulated F statistic of 1.96 (F.01, 9, 20), the sample is homogeneous; the variation within a single gallon is not significantly different from the variation between bottles. All aliquots of each of the three effluents analyzed were not significantly different from one another; i.e., they were homogeneous.

After verification of sample homogeneity, approval of analytical data, and preparation of sample concentrates, 4 gallons of each effluent sample were shipped to each subcontractor. Samples were packaged and shipped according to DOT regulations via air express carrier. In this manner, time delays were minimized since samples were received one day following shipment from ERCO, thus expediting chain-of-custody and resupply of lost or broken samples.

The actual method study was based on analysis of spiked and unspiked samples of each of the three raw wastewater effluents supplied by ERCO to each subcontractor laboratory, as well as on analysis of spiked and unspiked surface, drinking, and

Table 5. SUMMARY OF HOMOGENEITY TESTING

Analyte	Range of Concentrations (ug/L)		
	Effluent 1[a]	Effluent 2[b]	Effluent 3[c]
Ag	<0.5-0.6	4.6-7.6	<0.5-0.6
Al	14,000-17,000	130-190	all <10
As	10-14	all <10	all <10
Ba	91-101	12-15	34-42
Be	all <0.5	all <0.5	all <0.5
Cd	0.44-0.70	all <0.5	all <0.5
Co	all <15	all <15	all <15
Cr	12-14	all <10	all <10
Cu	53-62	194-210	all <10
Fe	500-560	340-390	<20-21
Mn	55-61	110-120	2.8-5.5
Ni	all <10	all <10	53-70
Pb	16-20	all <5	all <5
Sb	all <5	all <5	all <5
Se	all <10	all <10	all <10
Tl	all <5	all <5	all <5
V	21-26	all <10	770-880
Zn	1,100-1,200	23-30	all <10

[a]Paper industry effluent.

[b]Photographic industry effluent.

[c]Steam and electric industry effluent.

laboratory-pure waters supplied by each of the ten subcontractor laboratories. All spiked samples used by the ten laboratories were prepared by the subcontractor laboratories according to instructions supplied by ERCO using ERCO-prepared sample concentrates preserved in sealed glass ampules and containing the 18 elements of interest. Each sample of wastewater effluent was spiked at three concentration levels, with each level constituting a Youden Pair (two similar, but distinctly different concentrations). The spike (dosing) levels were prepared to represent one, two, and five times the background concentration in the effluent. In all cases, the lowest spike was at least twice the estimated detection limit of the method (1).

Similarly, three samples, one each from surface, drinking, and laboratory-pure water, were spiked at three levels (just above the detection limit, in the middle of the linear range, and near the upper limit of the linear range), with each spike level constituting a Youden Pair. Using this nonreplicate technique, precision for each laboratory was obtained as were estimates of accuracy and precision for the different matrices.

The three industrial effluents were analyzed by inductively coupled argon plasma emission spectrometry (ICAP) to provide preliminary estimates of the background levels of each element of interest and to provide estimates of possible interferences (Na, Ca, Mg). The ICAP data is presented in Table 6. These levels were used to calculate the spiking levels of the effluents.

The ICAP data were not in agreement with the homogeneity data (AA) for several cases - aluminum and silver in effluent 2 and silver in effluent 1. For effluent 2 the Al ICAP value was 410 ug/L while the AA range was 130 to 190 ug/L. This discrepancy is most likely due to a positive spectral interference from a high Ca

Table 6. PRELIMINARY CHARACTERIZATION OF EFFLUENT SAMPLES BY ICAP

Element	Concentration (ug/L)		
	Effluent 1a	Effluent 2b	Effluent 3c
Aluminum (Al)	16,600	410	<50
Antimony (Sb)	<150	<150	<150
Arsenic (As)	<10	<10	<10
Barium (Ba)	145	12	41
Beryllium (Be)	<5	<5	<5
Cadmium (Cd)	<10	<10	<10
Chromium (Cr)	25	<25	<25
Cobalt (Co)	<25	<25	<25
Copper (Cu)	90	291	<10
Iron (Fe)	835	380	<50
Lead (Pb)	30	<10	<10
Manganese (Mn)	75	114	<10
Nickel (Ni)	<25	<25	109
Selenium (Se)	<10	<10	<10
Silver (Ag)	3.2	62	<10
Thallium (Tl)	<10	<10	<10
Vanadium (V)	25	<10	918
Zinc (Zn)	1,430	30	<10
Calcium (Ca)	42,600	126,000	26,300
Magnesium (Mg)	1,240	2,270	39,200
Sodium (Na)	311,000	161,000	188,000

[a]Paper industry effluent

[b]Photographic industry effluent

[c]Steam and electric industry effluent

concentration (126,000 ug/L) on the ICAP value. Consequently, the Al spiking values for effluent 2 were slightly higher, twice those called for by the original scheme discussed below. For effluent 1, the AA values for silver were at or near the detection limit (0.5 ug/L) while the ICAP value was 3.2 ug/L (also near the detection limit). The spike levels were 10, 20, and 50 ug/L and recoveries were good. For effluent 2, the AA values for silver were in the range 4.6 to 7.6 ug/L while the ICAP value was 62 ug/L. Effluent 2 was a photographic effluent containing complexed silver which was not detected by the AA method. Spike recoveries were below 50% for all spike levels. This is discussed further in the Results and Discussion.

If an element was present in an effluent, the three pairs of spiking concentrates were made so that the spikes would be near the background concentration and at approximately two and five times that concentration. If an element was not detected, the pairs were prepared such that the spiked concentrations were near the detection limit (at least twice the detection limit), in the middle of the linear range and near the upper limit of the working range.

Three additional pairs of sample concentrates were prepared for spiking the samples of drinking, surface and laboratory-pure water. These concentrates were made so that the spiked water concentrations were slightly above the detection limit, in the center of the linear range and near the limit of the linear range. The exact concentrations for all spikes are shown in Table 7.

Production of reliable, stable concentrates required strict attention to purity and reactivity of metal-containing materials and dissolution reagents used during sample preparation. For production of sample concentrates for the interlaboratory

Table 7. CONCENTRATIONS IN THE SPIKED SAMPLES (mg/L)

Element	Water Spikes			Effluent One Spikes		
	Low	Medium	High	Low	Medium	High
Al	.0280/.0335	.0741/.0645	.125/111	12.6/11.0	21.7/25.7	58.3/49.6
Sb	.0110/.0127	.0568/.0473	.240/.200	.0105/.0122	.0543/.0452	.230/.191
As	.0124/.0120	.0518/.0618	.237/.211	.0118/.0098	.0496/.0591	.227/.202
Ba	.0627/.0591	.165/.194	.379/.437	.060/.0565	.157/.185	.362/.418
Be	.00063/.00047	.00159/.00191	.00909/.0114	.00064/.00045	.00152/.00183	.0087/.0109
Cd	.00045/.00079	.00455/.00532	.0125/.0101	.00043/.00076	.00435/.00509	.0120/.0097
Cr	.0103/.0135	.113/.0959	.200/.246	.00987/.0129	.108/.0917	.192/.236
Co	.0315/.0297	.186/.216	.420/.314	.0302/.0248	.230/.164	.309/.407
Cu	.0106/.0122	.0727/.0973	.205/.245	.0101/.0117	.0696/.0930	.196/.234
Fe	.0318/.0261	.236/.200	.455/.389	1.03/1.22	2.18/2.58	4.78/5.59
Pb	.0141/.0109	.0555/.0473	.254/.211	.0135/.0104	.0530/.0452	.243/.202
Mn	.00060/.00044	.00500/.00795	.0148/.0118	.0910/.107	.192/.220	.484/.420
Ni	.0274/.0311	.200/.240	.402/.482	.0262/.0297	.191/.230	.385/.461
Se	.0121/.0105	.0764/.0968	.205/.246	.0116/.0100	.0730/.0926	.197/.235
Ag	.00045/.00059	.00568/.00409	.0114/.0136	.00848/.0107	.0215/.0178	.0427/.0565
Tl	.0105/.0130	.120/.0986	.203/.252	.0100/.0124	.115/.0943	.194/.241
V	.175/.151	.404/.318	.982/.855	.167/.144	.387/.304	.939/.817
Zn	.00054/.00075	.00532/.00614	.0139/.0174	1.74/1.31	3.40/2.83	5.19/6.41

Table 7. (Continued)

	Effluent Two Spikes			Effluent Three Spikes		
Al	.46/.51	1.01/1.11	2.18/1.76	.0268/.0320	.0790/.0617	.120/.107
Sb	.0105/.0122	.0543/.0452	.230/.191	.0105/.0122	.0543/.0452	.230/.191
As	.0118/.0098	.0496/.0591	.227/.202	.0118/.0098	.0496/.0591	.227/.002
Ba	.060/.0565	.157/.185	.362/.418	.060/.0565	.157/.185	.362/.418
Be	.00064/.00045	.00152/.00183	.0087/.0109	.00064/.00045	.00152/.00183	.0087/.0109
Cd	.00043/.00076	.00435/.00509	.0120/.0097	.00043/.00076	.00435/.00509	.0120/.0097
Cr	.00987/.0129	.108/.0917	.192/.236	.00987/.0129	.108/.0917	.192/.236
Co	.0211/.0250	.250/.212	.461/.403	.0293/.0347	.211/.166	.435/.326
Cu	.36/.30	.65/.55	1.30/1.67	.0101/.0117	.0696/.0930	.196/.234
Fe	.42/.37	.88/.95	2.61/2.05	.0304/.0250	.226/.191	.435/.372
Pb	.0135/.0104	.0530/.0452	.243/.202	.0135/.0104	.0530/.0452	.243/.202
Mn	.151/.111	.227/.302	.666/.577	.00057/.00042	.00478/.00761	.0142/.0113
Ni	.0262/.0297	.191/.230	.385/.461	.0262/.0297	.191/.230	.385/.461
Se	.0116/.0100	.0730/.0926	.197/.235	.0116/.0100	.0730/.0926	.197/.235
Ag	.00848/.0107	.0215/.0178	.0427/.0565	.00848/.0107	.0215/.0178	.0427/.0565
Tl	.0100/.0124	.115/.0943	.194/.241	.0100/.0124	.115/.0943	.194/.241
V	.167/.144	.387/.304	.939/.817	1.58/1.36	2.34/2.70	5.29/6.03
Zn	.0302/.0246	.0507/.0650	.148/.189	.00051/.00072	.00509/.00587	.0133/.0167

method study, all reagents used for dissolution of pure metals or metal compounds were Ultrex™ materials supplied by J.T. Baker Co. Each lot number and the certified analysis for each reagent used were recorded prior to use during the study. Ultra-pure water was supplied by a Millipore Super-Q system containing an activated charcoal bed, two mixed bed ion-exchange columns, and a 0.2-u final filter. Water is supplied to the Super-Q system from a Millipore RO system containing two prefilters and a 60-L/hr reverse osmosis cartridge. Characteristics of the Super-Q water are as follows:

Total solids	<1 mg/L
Total organic carbon	<0.5 mg/L
Resistivity	>18 megohms
Ammonia-N	<0.01 mg/L
Total metals	<10 ug/L
Ionized material	<5 ug/L

This water was monitored continuously for the metals of interest while it was being used for preparation of sample concentrates.

All substances used as starting materials for production of sample concentrations were Spec-Pure™ (Spex Industries) or Johnson-Matthey pure metals or metal compounds. The elements were placed in five groups with each group ultimately comprising a mixed standard stock solution. Element groupings and compound selection were made utilizing the most recent recommendations of EPA personnel familiar with multi-element standard production.

For preparation of these stocks, all weighings were performed on a Mettler H51AR analytical balance capable of weighing to 0.00001 g. All metals or metal compounds were desiccated as

instructed by EPA (1) prior to weighing. During the dissolution of the metals or metal compounds, the amount of Ultrex acids was carefully recorded to allow precise adjustment of the final acid concentration.

For preparation of the solutions to be used for preparation of the sample concentrates, a given volume of each mixed standard stock solution was transferred to a volumetric flask and diluted to 1 liter with Super-Q water (all volumetric measurements were made with Class A pipettes and volumetrics). Prior to the final dilution, Ultrex nitric acid was added so the final concentration was 10 mL/L.

The solutions for each sample concentrate were prepared individually on a daily basis and the ampules for that concentrate were filled during the same workday from the same solution. Approximately 3 liters of solution were required for each concentrate. After preparation, the solution was transferred to a Teflon container and continually mixed with a Teflon-coated magnetic stirring bar. Approximately 23 mL of solution were transferred to ampules (Wheaton #6620 BB or Kimble #12012 u) that had been rinsed with cold tap water, hot tap water, and DIW followed by drying and steam autoclaving for 15 min at 121° C. The ampules were flame-sealed with a Carlisle ampule sealer. Two individuals were present to verify all measurements and recordings performed during ampule production.

All ampules were packaged in shipping containers and kept refrigerated. The ampules were shipped with the effluent samples via air express carrier at the initiation of the analytical portion of the interlaboratory method study.

METHOD FOR VERIFICATION OF TRUE VALUES, HOMOGENEITY, AND STABILITY OF SAMPLE CONTAINERS

After preparation of all sample concentrations, three ampules of each concentrate were drawn at random and analyzed. For each set of spike ampules, ten ampules were selected for analysis at 0, 45, and 90 days following preparation. Ampules were analyzed in duplicate by inductively coupled argon plasma emission spectroscopy (ICP) or atomic absorption spectrophotometry (AAS). For each time interval (0, 45, and 90 days), the mean and standard deviation of these analyses are presented in Table 8 along with the theoretical true value determined for each element. There was no evidence of instability either through loss to the glass or contamination from it. The average concentrations for days 0, 45, and 90 were nearly all within 5% of the theoretical value and all analyzed concentrations were within 10% of the theoretical value. In fact, all analyses were within 5% of the theoretical value except for the vanadium concentration in ampule 2a and aluminum in 1b and 9b.

ANALYSES OF DOSED EFFLUENT AND WATER SAMPLES BY SUBCONTRACTOR LABORATORIES

Following subsampling of effluent samples, preparation of sample concentrates, and testing for homogeneity and stability, 4 gallons of each effluent and the appropriate sample concentrate were shipped to each laboratory for analyses. Instructions for sample preparation and analysis were included as well as requirements for data submittal (45 days) and quality control.

Each laboratory performed the following dosing scheme:

1. Samples were spiked with the metals of interest and stirred with a magnetic mixer for 1 hr.

Table 8. RESULTS OF STABILITY TESTING OF SPIKE AMPULES

ELEMENT	AMPULE IDENTIFICATION	THEORETICAL	Concentration (mg/L) DAY 0	DAY 45	DAY 90
Al	1a	0.616	0.617±0.036	0.653±0.033	0.641±0.041
Sb	1a	0.242	0.241±0.004	0.246±0.004	0.239±0.002
As	1a	0.272	0.268±0.006	0.270±0.002	0.279±0.002
Ba	1a	1.38	1.41±0.08	1.44±0.03	1.37±0.05
Be	1a	0.0139	0.0140±0.0002	0.0137±0.0004	0.0145±0.0002
Cd	1a	0.0100	0.0105±0.0003	0.0103±0.0001	0.0105±0.0003
Cr	1a	0.227	0.230±0.001	0.226±0.002	0.229±0.002
Cu	1a	0.233	0.230±0.002	0.230±0.001	0.239±0.002
Fe	1a	0.699	0.699±0.005	0.706±0.003	0.719±0.005
Pb	1a	0.310	0.321±0.003	0.322±0.006	0.295±0.008
Mn	1a	0.0131	0.0126±0.0002	0.0127±0.0002	0.0125±0.0001
Ni	1a	0.603	0.602±0.001	0.603±0.003	0.609±0.008
Se	1a	0.266	0.275±0.006	0.272±0.005	0.272±0.003
Ti	1a	0.230	0.227±0.002	0.233±0.002	0.232±0.007
V	1a	3.84	3.84±0.03	3.83±0.01	3.93±0.01
Zn	1a	0.0118	0.0120±0.0010	0.0127±0.0020	0.0127±0.0010
Al	1b	0.737	0.682±0.011	0.742±0.041	0.786±0.013
Sb	1b	0.280	0.276±0.004	0.276±0.003	0.284±0.011
As	1b	0.225	0.221±0.002	0.219±0.011	0.233±0.006
Ba	1b	1.30	1.28±0.009	1.35±0.04	1.33±0.09
Be	1b	0.0103	0.0104±0.0003	0.0102±0.0004	0.0110±0.0004
Cd	1b	0.0174	0.0176±0.0003	0.0173±0.0003	0.0173±0.0003
Cr	1b	0.296	0.296±0.002	0.295±0.002	0.300±0.004
Cu	1b	0.268	0.262±0.002	0.265±0.001	0.274±0.001
Fe	1b	0.574	0.574±0.001	0.580±0.002	0.591±0.007
Pb	1b	0.239	0.240±0.005	0.250±0	0.249±0.004
Mn	1b	0.0097	0.0093±0.0001	0.0094±0.0002	0.0092±0
Ni	1b	0.684	0.686±0.008	0.688±0.009	0.697±0.016
Se	1b	0.230	0.236±0.005	0.243±0.002	0.234±0.003
Ti	1b	0.286	0.285±0	0.297±0.006	0.277±0.006
V	1b	3.32	3.31±0.01	3.33±0.03	3.39±0.01
Zn	1b	0.0165	0.0166±0.0002	0.0161±0.0009	0.0172±0.0004

Table 8 (CONT.)

ELEMENT	AMPULE IDENTIFICATION	THEORETICAL	Concentration (mg/L) DAY 0	DAY 45	DAY 90
Al	2a	1.63	1.63±0.07	1.58±0.01	1.69±0.06
Sb	2a	1.25	1.24±0.03	1.25±0.01	1.29±0.04
As	2a	1.14	1.12±0.02	1.14±0.01	1.12±0.03
Ba	2a	3.62	3.56±0.09	3.82±0.01	3.74±0.08
Be	2a	0.0350	0.0346±0.0002	0.0347±0.0003	0.0357±0.0009
Cd	2a	0.100	0.105±0.002	0.104±0.002	0.104±0.002
Cr	2a	2.49	2.51±0.01	2.52±0.02	2.55±0.02
Cu	2a	1.60	1.54±0.01	1.60±0.01	1.63±0.01
Fe	2a	5.20	5.12±0.02	5.27±0.04	5.31±0.03
Pb	2a	1.22	1.28±0.001	1.26±0.03	1.18±0.01
Mn	2a	0.110	0.111±0.001	0.112±0.001	0.115±0.002
Ni	2a	4.40	4.36±0.005	4.41±0.03	4.49±0.03
Se	2a	1.68	1.71±0.01	1.70±0.02	1.74±0.03
Ti	2a	2.64	2.55±0.09	2.68±0.06	2.68±0.08
V	2a	8.89	8.07±0.02	8.24±0.06	8.35±0.06
Zn	2a	0.117	0.123±0.002	0.116±0.002	0.117±0.001
Al	2b	1.42	1.41±0.04	1.43±0.08	1.42±0.03
Sb	2b	1.04	1.03±0.01	1.04±0.02	1.05±0.02
As	2b	1.36	1.37±0.02	1.38±0.02	1.34±0.02
Ba	2b	4.26	4.11±0.04	4.47±0.09	4.21±0.04
Be	2b	0.042	0.043±0.001	0.043±0.001	0.044±0.001
Cd	2b	0.117	0.119±0.002	0.120±0.002	0.120±0.002
Cr	2b	2.11	2.14±0.01	2.15±0.01	2.17±0.02
Cu	2b	2.14	2.09±0.01	2.14±0.01	2.18±0.02
Fe	2b	4.39	4.42±0.01	4.53±0.02	4.54±0.03
Pb	2b	1.04	1.08±0.02	1.06±0.01	1.09±0.02
Mn	2b	0.175	0.176±0.001	0.179±0.001	0.181±0.002
Ni	2b	5.29	5.24±0.01	5.30±0.03	5.42±0.06
Se	2b	2.13	2.11±0.04	2.11±0.02	2.14±0.02
Ti	2b	2.17	2.11±0.04	2.14±0.06	2.19±0.06
V	2b	6.99	6.99±0.01	7.14±0.03	7.18±0.05
Zn	2b	0.1350	0.143±0.002	0.140±0.001	0.141±0.001

Table 8 (CONT.)

ELEMENT	AMPULE IDENTIFICATION	THEORETICAL	Concentration (mg/L) DAY 0	DAY 45	DAY 90
Al	3a	2.75	2.70±0.02	2.77±0.04	2.81±0.13
Sb	3a	5.29	5.20±0.01	5.34±0.05	5.32±0.03
As	3a	5.22	5.13±0.08	5.27±0.07	5.27±0.13
Ba	3a	8.33	8.29±0.07	8.59±0.06	8.46±0.04
Be	3a	0.200	0.204±0.001	0.213±0.001	0.209±0.001
Cd	3a	0.276	0.274±0.002	0.278±0.002	0.275±0
Cr	3a	4.41	4.46±0.01	4.56±0.02	4.56±0.02
Cu	3a	4.51	4.35±0.02	4.60±0.02	4.57±0.02
Fe	3a	10.0	10.1±0.1	10.5±0.1	10.3±0.1
Pb	3a	5.59	5.61±0.03	5.58±0.04	5.57±0.03
Mn	3a	0.326	0.330±0.001	0.339±0.001	0.339±0.002
Ni	3a	8.85	8.77±0.09	8.93±0.04	8.90±0.02
Se	3a	4.52	4.45±0.02	4.52±0.04	4.57±0.02
Ti	3a	4.47	4.44±0.04	4.78±0.03	4.65±0.02
V	3a	21.6	21.8±0.1	22.6±0.1	22.6±0.1
Zn	3a	0.305	0.311±0.001	0.302±0.001	0.305±0.005
Al	3b	2.45	2.37±0.03	2.44±0.01	2.53±0.07
Sb	3b	4.40	4.36±0.02	4.49±0.05	4.39±0.02
As	3b	4.65	4.67±0.04	4.64±0.01	4.62±0.04
Ba	3b	9.62	9.16±0.05	9.92±0.05	9.78±0.18
Be	3b	0.250	0.258±0.003	0.264±0.001	0.257±0.002
Cd	3b	0.223	0.221±0.002	0.225±0.002	0.224±0.002
Cr	3b	5.42	5.39±0.04	5.46±0.01	5.42±0.03
Cu	3b	5.39	5.27±0.03	5.48±0.01	5.43±0.03
Fe	3b	8.56	8.49±0.07	8.74±0.01	8.44±0.09
Pb	3b	4.65	4.71±0.07	4.62±0.01	4.60±0.01
Mn	3b	0.260	0.264±0.001	0.268±0.001	0.266±0.002
Ni	3b	10.6	10.5±0.1	10.7±0.1	10.5±0.1
Se	3b	5.41	5.34±0.04	5.43±0.05	5.41±0.06
Ti	3b	5.55	5.35±0.02	5.67±0.01	5.63±0.05
V	3b	18.8	18.5±0.1	19.1±0.1	18.9±0.2
Zn	3b	0.383	0.388±0.003	0.377±0.002	0.384±0.019

Table 8 (CONT.)

ELEMENT	AMPULE IDENTIFICATION	THEORETICAL	Concentration (mg/L) DAY 0	DAY 45	DAY 90
Al	4a	290	289±3.2	291±1	290±4
Co	4a	0.694	0.704±0.008	0.698±0.002	0.679±0.004
Fe	4a	23.0	22.9±0.3	22.8±0.1	24.0±0.2
Mn	4a	2.08	2.13±0.03	2.07±0.01	2.18±0.03
Zn	4a	40.0	38.5±0.5	39.7±0.3	39.2±0.4
Al	4b	253	253±2	253±2	253±3
Co	4b	0.571	0.584±0.004	0.571±0.003	0.558±0.006
Fe	4b	27.5	28.1±0.2	27.8±0.2	29.2±0.6
Mn	4b	2.44	2.51±0.02	2.43±0.02	2.56±0.05
Zn	4b	30.0	29.6±0.2	30.1±0.1	29.8±0.5
Al	5a	498	494±1	508±3	491±2
Co	5a	4.67	4.71±0.01	4.73±0.17	4.53±0.02
Fe	5a	45.0	45.5±0.1	45.7±0.2	46.9±0.2
Mn	5a	4.30	4.32±0.01	4.24±0.02	4.39±0.02
Zn	5a	78.0	75.6±0.2	80.3±0.2	78.5±0.1
Al	5b	590	584±6	605±1	583±6
Co	5b	3.76	3.76±0.01	3.67±0.06	3.73±0.05
Fe	5b	55.0	55.3±0.4	55.8±0.1	57.9±0.9
Mn	5b	4.88	4.94±0.03	4.87±0.01	5.12±0.07
Zn	5b	65.0	64.4±0.4	65.5±0.1	65.0±0.6
Al	6a	1,337	1,228±8	1,360±28	1,313±24
Co	6a	7.10	7.14±0.05	6.97±0.17	7.16±0.12
Fe	6a	100	101±1	99±2	103±2
Mn	6a	10.8	10.9±0.1	10.5±0.2	11.1±0.2
Zn	6a	119	119±1	119±2	119±1
Al	6b	1,138	1,140±14	1,154±17	1,121±8
Co	6b	9.35	9.37±0.13	9.22±0.14	9.47±0.10
Fe	6b	120	122±2	121±2	126±1
Mn	6b	9.40	9.39±0.15	9.09±0.15	9.59±0.09
Zn	6b	147	143±2	145±2	143±1

Table 8 (CONT.)

ELEMENT	AMPULE IDENTIFICATION	THEORETICAL	Concentration (mg/L) DAY 0	DAY 45	DAY 90
Al	7a	10.0	10.45±0.15	9.83±0.06	9.51±0.01
Co	7a	5.75	5.92±0.05	5.79±0.01	5.55±0.02
Cu	7a	8.00	8.28±0.11	7.94±0.02	7.70±0.01
Fe	7a	8.95	9.35±0.11	8.83±0.03	8.66±0.01
Mn	7a	3.45	3.59±0.04	3.42±0.01	3.36±0.01
Zn	7a	0.682	0.719±0.008	0.676±0.002	0.652±0.004
Al	7b	10.9	11.4±0.1	10.8±0.1	10.9±0.4
Co	7b	4.87	4.92±0.11	4.96±0.02	4.74±0.02
Cu	7b	6.70	6.89±0.08	6.72±0.01	6.48±0.04
Fe	7b	7.90	8.15±0.17	7.88±0.02	7.70±0.07
Mn	7b	2.54	2.60±0.06	2.53±0.01	2.49±0.01
Zn	7b	0.550	0.569±0.01	0.550±0.01	0.532±0.01
Al	8a	21.5	22.0±0.3	20.8±0.1	20.1±0.1
Co	8a	0.485	0.485±0.005	0.493±0.004	0.477±0.002
Cu	8a	13.3	13.6±0.2	13.3±0.1	12.9±0.1
Fe	8a	15.0	15.3±0.2	14.8±0.1	14.7±0.1
Mn	8a	5.10	5.17±0.07	5.12±0.02	5.08±0.02
Zn	8a	1.05	1.10±0.01	1.07±0.01	1.03±0.01
Al	8b	24.0	25.0±0.1	23.7±0.2	22.8±0.1
Co	8b	0.575	0.577±0.02	0.586±0.006	0.563±0.003
Cu	8b	10.6	10.8±0.1	10.6±0.1	10.3±0.1
Fe	8b	17.5	17.7±0.1	17.2±0.2	17.0±0.1
Mn	8b	6.78	6.86±0.01	6.81±0.04	6.75±0.03
Zn	8b	1.36	1.41±0.01	1.38±0.01	1.33±0.01

Table 8 (CONT.)

ELEMENT	AMPULE IDENTIFICATION	THEORETICAL	Concentration (mg/L) DAY 0	DAY 45	DAY 90
Al	9a	47.5	49.5±0.2	48.3±0.4	44.7±0.1
Co	9a	10.6	10.7±0.1	10.7±0.1	10.4±0.1
Cu	9a	25.5	26.6±0.1	25.2±0.2	25.1±0.1
Fe	9a	50.0	51.0±0.3	49.0±0.3	48.4±0.1
Mn	9a	15.0	15.4±0.1	14.6±0.1	15.1±0.1
Zn	9a	3.10	3.26±0.01	3.07±0.02	3.04±0.01
Al	9b	38.0	39.9±0.3	38.9±0.2	35.9±0.1
Co	9b	9.27	9.38±0.07	9.35±0.02	9.08±0.02
Cu	9b	33.0	34.4±0.3	32.5±0.1	32.5±0.1
Fe	9b	38.7	39.9±0.5	38.4±0.2	37.9±0.1
Mn	9b	13.0	13.5±0.1	12.8±0.1	13.2±0.1
Zn	9b	3.96	4.15±0.02	3.87±0.01	3.86±0.01
Co	10a	0.675	0.675±0.004	0.681±0.002	0.668±0.003
V	10a	32.5	34.0±0.2	32.8±0.2	33.2±0.1
Co	10b	0.797	0.806±0.008	0.797±0.006	0.788±0.008
V	10b	28.0	28.8±0.3	27.4±0.3	28.0±0.2
Co	11a	4.85	4.86±0.01	4.90±0.09	4.80±0.02
V	11a	45.0	46.2±0.1	44.7±0.9	46.6±0.2
Co	11b	3.82	3.87±0.01	3.79±0.02	3.81±0.01
V	11b	55.0	56.5±0.1	53.2±0.2	56.8±0.1
Co	12a	10.0	9.86±0.15	9.95±0.06	9.83±0.15
V	12a	100	101±2	96.8±0.5	104±2
Co	12b	7.50	7.36±0.08	7.51±0.05	7.31±0.03
V	12b	120	122±2	119±1	125±1

Table 8 (CONT.)

ELEMENT	AMPULE IDENTIFICATION	THEORETICAL	Concentration (mg/L) DAY 0	DAY 45	DAY 90
Co	13a	0.693	0.696±0.009	0.682±0.006	0.700±0.005
Ag	13a	0.010	0.0108±0	0.0109±0.0001	0.0108±0.0002
Co	13b	0.653	0.662±0.002	0.643±0.002	0.653±0.003
Ag	13b	0.013	0.0127±0.0001	0.0128±0	0.0128±0.0002
Co	14a	4.10	4.18±0.06	3.97±0.02	4.14±0.03
Ag	14a	0.125	0.127±0.001	0.125±0.001	0.130±0.001
Co	14b	4.75	4.78±0.02	4.58±0.04	4.80±0.04
Ag	14b	0.090	0.0875±0.001	0.0879±0.001	0.0899±0.001
Co	15a	9.24	9.38±0.06	9.04±0.05	9.30±0.08
Ag	15a	0.250	0.245±0.001	0.253±0.001	0.252±0.001
Co	15b	6.90	6.95±0.03	6.79±0.03	6.97±0.001
Ag	15b	0.300	0.305±0.002	0.314±0.001	0.312±0.001
Ag	16a	0.195	0.195±0.003	0.195±0.003	0.193±0.003
Ag	16b	0.245	0.243±0.003	0.248±0.001	0.244±0.001
Ag	17a	0.495	0.490±0.002	0.501±0.002	0.497±0.002
Ag	17b	0.410	0.409±0.003	0.420±0.001	0.412±0.001
Ag	18a	0.982	0.961±0.002	0.993±0.005	0.992±0.002
Ag	18b	1.30	1.27±0.001	1.33±0.01	1.31±0.01

2. The samples were then capped and stored at room temperature (approximately 20° C) for 1 week (7 days).

3. The pH was adjusted to pH of 2 or less with 1:1 nitric acid and refrigerated for 24 hr.

4. The samples were then prepared and analyzed according to the U.S. EPA Methods.

5. No deviations from the U.S. EPA methods were permitted nor were further restrictions applied, i.e., use of background correction, use of coated or treated graphite were not required or prohibited.

The type and number of analyses that were required of each laboratory are shown in Table 9.

QUALITY ASSURANCE REQUIREMENTS FOR PARTICIPATING LABORATORIES

The quality assurance plan utilized to monitor the performance of the subcontractor laboratories was based on the ongoing quality assurance plan used routinely by ERCO's Trace Metals Laboratory for all in-house work. At a minimum, all subcontractor laboratories were required to adhere to the guidelines set forth in that plan.

The quality assurance plan for all participating laboratories also contained the following elements:

1. As part of the preliminary screening phase, each subcontractor laboratory was required to submit detailed summaries of qualifications of all personnel working on this project.

2. After the preliminary screening phase, each potential subcontractor laboratory was required to participate in an ERCO-conducted performance evaluation study.

3. Each subcontractor laboratory was required to retain all pertinent raw data, finished data, and QC data generated during this study until final disposition of the data is determined by EPA and/or ERCO.

Table 9. TYPE AND NUMBER OF ANALYSES

Type of analysis	Number of analyses[a]
Background analyses for the metals of interest in laboratory-pure water (18 metals)	18
Background analyses for the metals of interest in drinking water (18 metals)	18
Background analyses for the metals of interest in surface water (18 metals)	18
Background analyses for the metals of interest in effluents (18 metals x 3 effluents)	54
Analyses for the metals of interest in the six water types (laboratory-pure water, drinking water, surface water, and the three industrial effluents) dosed with each of the sample concentrates:	
- 5 water types[b] x 6 concentrates x 18 metals	540
- 1 water type[c] x 12 concentrates x 18 metals	216
Total number of analyses	864

[a]An analysis is the determination of one metal in one sample.

[b]Surface water, drinking water, and three effluents.

[c]Laboratory-pure water.

4. Each subcontractor laboratory was required to adhere to procedures for sample preparation and analysis supplied by ERCO. At a minimum, calibration curves consisted of a blank and four standards within the appropriate linear range. Instrument check standards containing the element of interest at concentrations approximating the midpoint of the calibration curve were run at the beginning and end of the day and at a frequency of 10% during sample analysis. If results did not agree to within 10% of the true value, analysis was terminated. After the problem was resolved and the instrument was recalibrated, all samples analyzed since the last successful check standard were reanalyzed.

COMPUTER PROCESSING OF LABORATORY DATA

The participating laboratories supplied data on forms provided by ERCO. This data was then entered onto hard disc files from which the data was processed by the IMVS program supplied by EPA. All the raw data and the statistical summaries generated by the IMVS program are included in Appendix C and summarized in sections 2 and 5 of this report.

SECTION 4

TREATMENT OF DATA

The objective of this interlaboratory study was to obtain information about the accuracy and precision associated with measurements generated by the furnace methods. This objective was met through the use of statistical analysis techniques designed to extract and summarize the relevant information about accuracy and precision from the data reported by the participating laboratories. The statistical techniques employed in the data reduction process are similar to the techniques suggested in the ASTM Standard Practice D2777-77 (5).

The algorithms required to perform the statistical analyses have been integrated into a U.S. EPA system of computer programs referred to as IMVS. The analyses performed by IMVS include several tests for the rejection of outliers (laboratories and individual data points), summary statistics by concentration level for mean recovery (accuracy), overall and single-analyst standard deviation (precision), determination of the linear relationship between mean recovery and concentration level, determination of the linear relationship between the precision statistics and mean recovery, and a test for the effect of water type on accuracy and precision.

A detailed description of each of the statistical analysis procedures follows.

REJECTION OF OUTLIERS

Since the objective of the statistical analysis is to summarize the general behavior of the method in terms of accuracy and precision, it is important to identify data points which are inconsistent with the majority of the data. These data points should be deleted from the analysis because they can lead to values of summary statistics which are not representative of the general behavior of the method. However, some erratic behavior in the data may be directly related to some facet of the method under study. Therefore, inconsistent data points should not be removed indiscriminately, and any points that are removed should be clearly identified since further investigation of the analytical conditions related to the outliers might be of value. In some cases the data points which are deleted may actually be closer to the true value than the retained data. This is not inconsistent since outliers are judged relative to the average value of the data and not with respect to the true value. Data rejected as outliers for this study as a result of any of the following tests for outliers have been identified by the symbol "*" in the raw data tables.

Youden's Laboratory Ranking Procedure

In some cases, the analytical values reported by a specific laboratory are so consistently high or low that a large systematic error may be attributed to that laboratory. These data are not representative of the method and should be rejected. Youden's (2) ranking test for outlying laboratories was applied separately to data from each of the waters used in this study.

The Youden laboratory ranking procedure requires a complete set of data from every laboratory within a given water type. Missing data from laboratory i for water type j were replaced by

the following procedure. Letting X_{ijk} denote the reported measurement from laboratory i for water type j and concentration level C_k, it is assumed that

$$X_{ijk} = \beta_j \cdot C_k^{\nu_j} \cdot L_i \cdot \varepsilon_{ijk}$$

where β_j and ν_j are fixed parameters which determine the effect of water type j, L_i is the systematic error due to laboratory i and ε_{ijk} is the random within the laboratory error. Taking natural logarithms, it follows that

$$\ln X_{ijk} = \ln \beta_j + \nu_j \ln C_k + \ln L_i + \ln \varepsilon_{ijk}$$

which is a linear regression model with dependent variable $\ln X_{ijk}$ and independent variable $\ln C_k$. Details and justification for this model are discussed in the section "Comparison of Accuracy and Precision Across Water Types."

The natural logarithms of the individual laboratory's data were regressed against the natural logarithms of the true concentration levels for the six ampules in each water type. The predicted values $\ln\hat{X}_{ijk}$ were obtained from the regression equation, and the missing values of X_{ijk} were estimated by $\hat{X}_{ijk} = \exp(\ln \hat{X}_{ijk})$, where exp(x) denotes the constant e raised to the power X.

If the ranking test rejected a laboratory for a specific water type, then all the laboratory's data for that water type were rejected as outliers. The rejected values were excluded from all the remaining analyses. In addition, after completion of the laboratory ranking procedure, the predicted values created to fill in for the missing data were rejected and excluded from further analyses for all laboratories.

Individual Outliers

The data remaining after the laboratory ranking procedure were grouped by water type. For each water type, the data were broken down into six subsets defined by the six concentration levels (ampules) used in the study. For each subset of the data, all missing, zero, "less than," and "nondetect" data were rejected. Next, the test for individual outliers constructed by Thompson(6), and suggested in the ASTM Standard Practice D2777-77, was applied to the data using a 5 percent significance level. If an individual data point was rejected upon the basis of this test, it was removed from the subset, and the test was repeated using the remaining data in the subset. This process was continued until no additional data could be rejected.

STATISTICAL SUMMARIES

Several summary statistics were calculated using the data remaining for each concentration level after the outlier rejection tests were performed: the number of retained data points, the mean recovery, accuracy as a percent relative error, the absolute overall standard deviation, the percent relative overall standard deviation, the absolute single-analyst standard deviation, and the percent relative single-analyst standard deviation. The basic formulas used to calculate these statistics are presented below (X_1, X_2,..., X_n denote the values of the n retained data points for a specific concentration level):

Mean Recovery (X):

$$X = \frac{1}{n} \sum_{i=1}^{n} X_i$$

The usual concentration notation for mean recovery is $\bar{X}$. However, the symbol X is used in this report to be consistent with the IMVS output.

Accuracy as a Percent Relative Error:

$$\text{Percent RE} = \frac{X - \text{True Value}}{\text{True Value}} \cdot 100$$

Overall Standard Deviation:

$$S = \sqrt{\frac{1}{n-1} \sum_{i=1}^{n} (X_i - X)^2}$$

and

Percent Relative Overall Standard Deviation:

$$\text{Percent RSD} = \frac{S}{X} \cdot 100$$

The overall standard deviation S indicates the precision associated with measurements generated by a group of laboratories. This represents the broad variation in the data collected in an interlaboratory study. However, a measure of how well an individual analyst can expect to perform in his own laboratory is another important measure of precision. This single-analyst precision, denoted by SR, was estimated for each Youden pair by

$$SR = \sqrt{\frac{1}{2(m-1)} \sum_{i=1}^{m} (D_i - \bar{D})^2}$$

where

m = the number of complete sets of Youden pair observations remaining after outliers have been removed,

D_i = the difference between the observations in the ith Youden pair

and

$\bar{D}$ = average of the D_i values.

The percent relative single-analyst standard deviation was calculated by

$$\text{Percent RSD-SR} = \frac{SR}{X^*} \cdot 100$$

where X* is the average of the two mean recovery statistics corresponding to the two concentration levels defining the particular Youden pair.

These summary statistics provide detailed information on the accuracy and precision of the data obtained for each concentration level. One objective of the statistical analysis of the data is to summarize the information about accuracy and precision which is contained in the statistics.

A systematic relationship often exists between the mean recovery (X) and the true concentration level (C) of the analyte in the sample. In addition there are often systematic relationships between the precision statistics (S and SR) and the mean recovery (X). Usually these systematic relationships can be adequately approximated by a linear relationship (i.e., by a straight line).

Once these straight lines are established, they can be used to conveniently summarize the behavior of the method within a water type, and they can aid in comparing the behavior of the method across water types. In addition they can be used to obtain estimates of the accuracy and precision at any concentration level within the applicable range studied. They can also be used to predict the behavior of the method when used under similar conditions. These important relationships are discussed below.

STATEMENT OF METHOD ACCURACY

The accuracy of the method is characterized by the relationship of the mean recovery (X) to the true concentration (C) of the analyte in the water sample. In order to obtain a mathematical expression for this relationship, a regression line of the form

$$X = a + b \cdot C \qquad (1)$$

was fitted to the data by regression techniques.

The true concentration values often vary over a wide range. In such cases, the mean recovery statistics associated with the larger concentration values tend to dominate the fitted regression line producing relatively larger errors in the estimates of mean recovery at the lower concentration values. In order to eliminate this problem, a weighted least squares technique was used to fit the mean recovery data to the true concentration values. The weighted least squares technique was performed by dividing both sides of Equation (1) by C resulting in Equation (2)

$$\frac{X}{C} = a \cdot \frac{1}{C} + b \qquad (2)$$

The (X/C) values were regressed against the (1/C) values using ordinary least squares to obtain estimates for the values of a and b. (This is equivalent to performing a weighted least squares with weights $w = 1/C^2$; see Reference (7), page 108 for details.) Equation (2) can easily be converted to the desired relationship given by Equation (1). The intercept (b) from Equation (2) becomes the slope (b) for Equation (1) and slope (a) from Equation (2) becomes the intercept (a) for Equation (1). Equation (1) can be used to calculate the percent recovery over the applicable range of concentrations used in the study.

The percent recovery is given by

$$\text{Percent Recovery} = \frac{a + b \cdot C}{C} \cdot 100 = \frac{a}{C} \cdot b \cdot 100 \quad (3)$$

If the absolute value of the ratio (a/C) is small relative to the slope (b) for the low concentration levels used in the study, then the percent recovery can be approximated by b · 100. For example, suppose the true concentration values range from 25 ug/L to 515 ug/L, and the fitted line is given by $X = 0.20 + 0.85 \cdot C$. The percent recovery would be approximated by $0.85 \cdot 100 = 85\%$ over the specified range of 25 ug/L to 515 ug/L.

If the ratio (a/C) is not small relative to the slope (b), then the percent recovery depends upon the true concentration (C), and it must be evaluated at each concentration value within the specified range.

STATEMENT OF METHOD PRECISION

The precision of the method is characterized by the relationships between precision statistics (S and SR) and mean recovery (X). In order to obtain a mathematical expression for these relationships, regression lines of the form

$$S = d + e \cdot X \tag{4}$$

and

$$SR = f + g \cdot X^* \tag{5}$$

were fitted to the data by regression techniques.

As discussed previously with respect to accuracy, the values of X and X* often vary over a wide range. In such cases, the standard deviation statistics associated with the larger mean recovery values will dominate the regression lines. This will produce relatively larger errors in the estimates of S and SR at the lower mean recovery values. Therefore, a weighted least squares technique was also used to establish the values of the parameters d, e, f, and g in Equations (4) and (5). The weighted least squares technique was performed by dividing both sides of Equation (4) by X resulting in Equation (6)

$$\frac{S}{X} = d \cdot \frac{1}{X} + e \tag{6}$$

and by dividing both sides of Equation (5) by X* resulting in Equation (7)

$$\frac{SR}{X^*} = f \cdot \frac{1}{X^*} + g \tag{7}$$

The (S/X) values were regressed against the (1/X) values and the (SR/X*) values were regressed against the (1/X*) values using ordinary least squares to obtain estimates for the parameters d, e, f, and g.

Equations (4) and (5) were obtained from Equations (6) and (7) in a manner similar to that discussed for mean recovery. The slope (d) for Equation (6) is the intercept (d) for Equation (4), and the intercept (e) for Equation (6) is the slope (e) for Equation (4). Similarly, the slope (f) for Equation (7) is the intercept (f) for Equation (5), and the intercept (g) for Equation (7) is the slope (g) for Equation (5).

Given Equations (4) and (5), the percent relative overall standard deviation and the percent relative single-analyst standard deviation are

$$\text{Percent RSD} = \frac{d}{X} + e \cdot 100 \qquad (8)$$

and

$$\text{Percent RSD-SA} = \frac{f}{X^*} + g \cdot 100 \qquad (9)$$

respectively. If the absolute value of the ratio (d/X) is small relative to the slope (e), then the percent relative overall standard deviation can be approximated by (e · 100) over the applicable range of mean recovery values. Similarly if the ratio (f/X*) is small relative to the slope (g), then the percent relative single-analyst standard deviation can be approximated by (g · 100) over the applicable range of mean recovery values. If the ratios (d/X) and (f/X*) are not small relative to the slopes (e) and (f),

then the percent relative standard deviations depend upon the values of the mean recovery statistics X and X*, and they should be evaluated separately for each value of X and X*.

COMPARISON OF ACCURACY AND PRECISION ACROSS WATER TYPES

It is possible that the accuracy and precision of the furnace methods depend upon the type of water being analyzed. The summary statistics X, S, and SR are calculated separately for each concentration level within each water type. The summary statistics can be compared across water types in order to obtain information about the effects of water type on accuracy and precision. However, the use of these summary statistics in this manner has several disadvantages. First, it is cumbersome since there are 36 mean recovery statistics (X) (6 concentrations x 6 waters), 36 precision statistics (S), and 18 precision statistics (SR) calculated for each element. Comparison of these statistics across concentration levels and across water types becomes unwieldy. Second, the statistical properties of this type of comparison procedure are difficult to determine. Finally, due to variation associated with X, S, and SR, comparisons based on these statistics can lead to inconsistent conclusions about the effect of water type. For example, distilled water may produce a significantly lower value than surface water for the precision statistic S at a high concentration, but a significantly higher value for S at a low concentration.

An alternative approach, described in detail (8), has been developed to test for the effects of water type. This alternative approach is based on the concept of summarizing the average effect of water type across concentration levels rather than studying the

local effects at each concentration level. If significant differences are established by this alternative technique, then the summary statistics can be used for further local analysis.

The test for the effect of water type is based on the following statistical model. If X_{ijk} denotes the measurement reported by laboratory i, for water type j, and ampule k, then

$$X_{ijk} = \beta_j \cdot C_k^{\nu_j} \cdot L_i \cdot \varepsilon_{ijk} \qquad \begin{matrix} i = 1,2,\ldots, n \\ j = 1,2,\ldots, 6 \\ k = 1,2,\ldots, 6 \end{matrix} \qquad (10)$$

The model components β_j and ν_j are fixed parameters which determine the effect of water type j on the behavior of the observed measurements (X_{ijk}). The parameter C_k is the true concentration level associated with ampule k. The model component L_i is a random factor which accounts for the systematic error associated with laboratory i. The model component ε_{ijk} is the random factor which accounts for the within-laboratory error.

The model is designed to approximate the global behavior of the data. The multiplicative structure was chosen because of two important properties. First, it allows for a possible curvilinear relationship between the data (X_{ijk}) and the true concentration level C_k through the use of the exponent ν_j on C_k. This makes the model more flexible in comparison to straight line models. Second, as will be seen below, there is an inherent increasing relationship between the variability in the data and the concentration level C_k in this model. This property is important because it is typical of interlaboratory data collected under conditions where the true concentration levels vary widely.

Accuracy is related directly to the mean recovery or expected value of the measurements (X_{ijk}). The expected value for the data modeled by Equation (10) is

$$E(X_{ijk}) = \beta_j \cdot C_k^{\nu j} \cdot E(L_i \cdot \varepsilon_{ijk}) \qquad (11)$$

Precision is related to the variability in the measurements (X_{ijk}). The variance of the data modeled by Equation (10) is

$$Var(X_{ijk}) = \left[\beta_j \; C_k^{\nu_j}\right]^2 \; Var(L_i \cdot \varepsilon_{ijk}) \qquad (12)$$

which is an increasing function of C_k.

The effect of water type on the accuracy and precision of the methods is determined by the values of the parameters (β_j) and (ν_j) in Equations (11) and (12). If the (β_j) and (ν_j) vary with j (i.e., vary across water type), then the accuracy and precision of the method also vary across water type.

In order to determine if these parameters do vary across water type and to compare their values, they must be estimated from the laboratory data using regression techniques. Equation (10) represents the basic model. However, taking natural logarithms of both sides of Equation (10), the following straight line regression model is obtained:

$$\ln X_{ijk} = \ln \beta_j + \nu_j \ln C_k + \ln L_i + \ln \varepsilon_{ijk} \qquad (13)$$

which can be analyzed using standard linear model analysis techniques. The parameter $\ln \beta_j$ is the intercept and ν_j the slope of the regression line associated with water type j. It is assumed that

$\ell n\ L_i$ is normally distributed with mean 0 and variance σ_L, and that $\ell n\ \varepsilon_{ijk}$ is normally distributed with mean 0 and variance σ_ε^2, and that the ($\ell n\ L_i$) and ($\ell n\ \varepsilon_{ijk}$) terms are independent.

Based on Equation (13), the comparison of water types reduces to the comparison of straight lines. Distilled water is viewed as a control, and each of the remaining lines is compared directly to the line for distilled water.

Using the data on the log-log scale and regression techniques, the parameters $\ell n\ \beta_j$ (and hence β_j) and ν_j can be estimated. The estimates are then used to test the null hypothesis that there is no effect due to water type. The formal null and alternative statistical hypotheses H_O and H_A are given by

$$H_O: \ell n\ \beta_j - \ell n\ \beta_1 = 0 \text{ and } \nu_j - \nu_1 = 0 \text{ for } j = 2,3,4,5,6$$

versus

$$H_A: \ell n\ \beta_j - \ell n\ \beta_1 \neq 0 \text{ and/or } \nu_j - \nu_1 \neq 0$$
for some $j = 2,3,4,5,6$.

The test of null hypothesis H_O against the alternative hypothesis H_A is based on an F-statistic derived from standard linear model theory. The probability of obtaining a value of an F-statistic as large as the value which was actually observed (F_{obs}), denoted by $P(F > F_{obs})$, is calculated under the assumption that H_O is true. The null hypothesis H_O is rejected in favor of H_A if $P(F > F_{obs})$ is less than 0.05.

If H_O is rejected, then some linear combination of the differences $\ell n\ \beta_j - \ell n\ \beta_1$ and $\nu_j - \nu_1$ is statistically different from zero. However, this does not guarantee there will be a statistically

significant direct effect attributable to any specific water type since the overall F test can be overly sensitive to minor systematic effects common to several water types. The effect due to a specific water type is judged to be statistically significant only if one of the differences $\ell n\ \beta_j - \ell n\ \beta_1$ and/or $\nu_j - \nu_1$ is statistically different from zero. This is determined by checking the simultaneous 95 percent confidence intervals which are constructed for each of these differences. Each true difference can be stated to lie within its respective confidence interval with 95 percent confidence. If zero is contained within the confidence interval, then there is no evidence that the corresponding difference is significantly different from zero.

If at least one of the confidence intervals for the differences $\ell n\ \beta_j - \ell n\ \beta_1$ or $\nu_j - \nu_1$ fails to include zero, then the statistical significance of the effect due to water type has been established. However, establishment of a statistically significant effect due to water type does not necessarily mean that the effect is of practical importance. Practical importance is related to the size and interpretation of the difference.

The interpretation of the differences involves comparing the mean recovery and standard deviation of the (X_{ijk}) data for each water type to the mean recovery and standard deviation obtained for distilled water. These comparisons are made on a relative basis. The mean recovery for water type j is given by Equation (11). The mean recovery for water type j is compared to that for distilled water (j = 1) on a relative basis by the ratio

$$\frac{E(X_{ijk})}{E(X_{ilk})} = \frac{\beta_j C_k \nu^j \quad E(L_i \cdot \varepsilon_{ijk})}{\beta_1 \quad C_k \nu^1 \; E(L_i \cdot \varepsilon_{ilk})} = \frac{\beta_j}{\beta_1} C_k^{(\nu_j - \nu_1)} \qquad (14)$$

(The ratio of the standard deviations would be equivalent to Equation (14) and therefore the interpretation of the effect on precision is the same as that for the effect on mean recovery.)

The ratio in Equation (14) is a measure of the relative difference in mean recovery between water type j and distilled water. It is composed of two parts: (a) β_j/β_1, which is independent of the true concentration level (i.e. the constant bias), and (b) $C_k^{\nu j - \nu 1}$ which depends upon the true concentration level (i.e. the concentration dependent bias). If $\nu_j - \nu_1$ is zero, then the relative difference in mean recovery is just β_j/β_1, which is independent of concentration level C_k. It can then be stated that the mean recovery of water type j is (β_j/β_1) x 100 percent of the mean recovery for distilled water. If $\nu_j - \nu_1$ is not zero, then the mean recovery of water type j is $([\beta_j/\beta_1] \cdot C_k^{\nu j - \nu 1})$ x 100 percent of that for distilled water, and therefore depends upon the true concentration level C_k.

In order to illustrate these points, consider the following example. Suppose that a significant F-value has been obtained, and the confidence intervals for all the differences contain zero except for water type 5. Suppose for water type 5, the point estimate for $\ln \beta_5 - \ln \beta_1$ is -0.38 and the confidence interval for $\ln \beta_5 - \ln \beta_1$ is (-0.69, -0.07). Suppose the point estimate for $\nu_5 - \nu_1$ is 0.07, and the confidence interval for $\nu_5 - \nu_1$ is (-0.04, 0.18). In this case, a statistically significant effect due to water type has been established which involves only water type 5. The practical significance of this effect is judged by considering Equation (14). The ratio of mean recoveries for water type 5 and distilled water is given by

$$\frac{E(X_{i5k})}{E(X_{i1k})} = \frac{\beta 5}{\beta 1} C_k^{(\nu 5 - \nu 1)} \qquad (15)$$

and the ratio of the standard deviations is given by

$$\sqrt{\frac{\mathrm{Var}(X_{ijk})}{\mathrm{Var}(X_{ilk})}} = \frac{\beta_5}{\beta_1} \; C_k^{(\nu_5 - \nu_1)} \quad . \qquad (16)$$

Since the confidence interval for $\nu_5 - \nu_1$ contains zero, this difference is assumed to be insignificant and is set to zero. Therefore, Equations (15) and (16) reduce to β_5/β_1. The point estimate for $\ell n\ \beta_5 - \ell n \beta_1$ was -0.38. Therefore, the point estimate for β_5/β_1 is 0.68, and the mean recovery for water type 5 is estimated to be 68 percent of the mean recovery for distilled water. Similarly, the standard deviation for the data for water type 5 is estimated to be 68 percent of the standard deviation for distilled water. Since the 95 percent confidence interval for $\ell n\ \beta_5 - \ell n\ \beta_1$ was (-0.69, -0.07), any value in the interval (0.50, 0.93) is a reasonable estimate for β_5/β_1, and the mean recovery (standard deviation) for water type 5 can be claimed to be from 50 percent to 93 percent of the mean recovery (standard deviation) for distilled water. The practical significance of the effect due to water type 5 would depend upon the importance of a mean recovery (standard deviation) which is between 50 percent and 93 percent of the mean recovery (standard deviation) observed for distilled water.

The comparison of accuracy and precision across water types just discussed, is based on the assumption that Equation (10) approximately models the data. It is clear that in practical monitoring programs of this type such models cannot model the data completely in every case. This analysis, therefore, is viewed as a screening procedure which identifies those cases where differences in water types are likely to be present. A more detailed, local analysis can then be pursued using the basic summary statistics for precision and accuracy.

SECTION FIVE

RESULTS AND DISCUSSION

The statistical analysis procedures described in the preceding section were applied to the raw data for the 10 laboratories. The results of those analyses are discussed below.

Prior to a discussion of the results of the recoveries obtained by each of the laboratories, it is instructive to examine the results of analyses for each element in each of the three effluents. All of the data entered into the IMVS program were for concentrations of the spikes determined in each of the six waters, that is, the background level of each element in each water or effluent was subtracted from the concentration of the spiked water or effluent and the increase (amount recovered) reported.

The three water samples (lab pure, drinking and surface) were supplied by each individual laboratory and were consequently not analyzed by ERCO or by any of the other nine laboratories. The three effluents, however, were analyzed by all ten labs, by ERCO using the same (AAS) methods and by ERCO using inductively coupled plasma emission spectrometry (ICP). The results of these analyses of the unspiked effluents are presented in Table 10.

These data clearly demonstrate problems with certain analyses by certain laboratories. The most obvious discrepancies are for Al and Zn in all effluents. The large range of results indicate frequent and presumably reproducible errors. The results for Al in effluent 1 range from not detected ($\sim$10 ug/L) to 29,240 ug/L. Laboratory 5 was unable to detect Al in any of the effluents. For effluent 3, which had low Al levels, one laboratory reported

Table 10. EFFLUENT BACKGROUND CONCENTRATIONS DETERMINED BY THE TEN LABORATORIES

Effluent 1. (Concentrations in ug/L)

Element	Laboratory											
	1	2	3	4	5	6	7	8	9	10	ERCO AA*	ERCO ICP**
Al	29,240	19,100	16,600	19,000	ND	6,000	7,900	11,500	21,500	15,000	14-17,000	16,600
Sb	1.81	ND	ND	ND	19	6	ND	ND	ND	ND	<5	<150
As	19.3	ND	43.7	5.0	10	17	20	ND	38.2	10	10-14	<10
Ba	5,440	104	112	140	10	150	79	30	74.9	125	91-101	145
Be	0.93	ND	ND	ND	ND	ND	ND	ND	ND	ND	<0.5	<5
Cd	0.23	9.3	3.7	2.0	2	2.3	0.5	ND	0.64	0.6	0.44-0.70	<10
Cr	16.75	13.2	10.4	12	12	51	11	12	15.0	20	12-14	25
Co	9.23	19	7.5	5.0	9	7	ND	ND	24.7	ND	<15	<25
Cu	69.8	52	76.7	56	ND	58	62	51	32.2	65	53-62	90
Fe	660	491	1,270	730	1,460	790	480	950	626	800	500-560	835
Pb	21.5	ND	18.9	8.5	12	31	ND	20	19.8	19	16-20	30
Mn	75.2	39	67.1	50	62	77	74	51	110	70	55-61	75
Ni	15.3	ND	11	ND	4	62	10	30	17.8	8	<10	<25
Se	0.90	ND	30.8	ND	6	23	3	6	14.5	5	<10	<10
Ag	0.81	ND	2.7	ND	1	ND	ND	ND	0.43	ND	<0.5-0.6	3.2
Tl	1.12	ND	12.5	ND	ND	ND	ND	ND	ND	1	<5	<10
V	77.4	75	19.7	18	48	ND	17	ND	26.9	25	21-26	25
Zn	1,170	1,270	20,300	2,800	500	1,480	1,000	4,850	1,670	2,000	1,100-1,200	1,430

*ERCO data from the homogeneity testing (Table 5).

**ERCO data from the preliminary effluent characterization (Table 6).

Table 10. (Continued)

Effluent 2. (Concentrations in ug/L)

Element	Laboratory 1	2	3	4	5	6	7	8	9	10	ERCO AA*	ERCO ICP**
Al	31.5	206	291	210	ND	120	760	170	142	300	130-900	410
Sb	1.85	4	ND	ND	12	2	ND	ND	0.9	ND	<5	<150
As	ND	3	22.3	ND	ND	15	7	ND	12.2	ND	<10	<10
Ba	208	29	30.9	17	ND	20	17	226	ND	25	12-15	12
Be	0.91	ND	ND	ND	ND	0.1	ND	ND	0.2	ND	<0.5	<5
Cd	0.60	ND	1.70	0.6	1	2.6	0.4	ND	0.3	0.6	<0.5	<10
Cr	8.31	8	ND	ND	3	106	8	5	6.5	15	<10	<25
Co	8.13	11	2.1	ND	5	ND	ND	ND	0.72	ND	<15	<25
Cu	223	220	219	240	109	209	200	165	69.5	200	194-210	291
Fe	598	482	1,040	360	800	830	300	378	263	500	340-390	380
Pb	3.58	2	5.0	5.0	2	ND	ND	ND	ND	6	<5	<10
Mn	146	90	77.0	120	76	274	144	107	90.5	200	110-120	114
Ni	11.1	4	17	6.0	6	21	12	30	9.9	10	<10	<25
Se	2.12	3	53.3	ND	23	8	3	12	28.8	5	<10	<10
Ag	13.7	15.8	3.5	8.4	11	1.2	15	6.9	1.18	12	4.6-7.6	62
Tl	1.57	ND	3.7	ND	ND	ND	ND	ND	0.34	1	<5	<10
V	17.8	112	16.2	ND	32	ND	ND	ND	7.26	ND	<10	<10
Zn	513	20.6	69.6	900	390	1,360	16	510	39.6	20	23-30	30

*ERCO data from the homogeneity testing (Table 5).

**ERCO data from the preliminary effluent characterization (Table 6).

Table 10. (Continued)

Effluent 3. (Concentrations in ug/L)

Element	Laboratory											
	1	2	3	4	5	6	7	8	9	10	ERCO AA*	ERCO ICP**
Al	33.7	2	38.1	ND	ND	260	1,900	ND	68.2	ND	<10	<50
Sb	2.51	8	11.9	ND	16	3	ND	ND	2.8	ND	<5	<150
As	4.0	5	33.8	ND	ND	9	13	ND	53.5	10	<10	<10
Ba	197	72	49.8	47	46	42	34	53	ND	95	34-42	41
Be	0.62	1.1	ND	ND	ND	ND	ND	ND	ND	ND	<0.5	<5
Cd	0.30	0.4	1.20	ND	1	0.6	ND	ND	0.08	ND	<0.5	<10
Cr	16.21	2	13.0	ND	2	19	3	4	ND	8	<10	<25
Co	9.88	30	7.7	ND	2	ND	ND	ND	2.7	ND	<15	<25
Cu	15.7	5	20.9	ND	1	2	7	9.1	20.0	2	<10	<10
Fe	114	106	57.0	110	107	ND	54	28	46.5	26	<20-21	<50
Pb	6.45	23	7.1	ND	ND	ND	ND	ND	3.7	3	<5	<10
Mn	2.58	2	1.2	ND	ND	ND	ND	ND	8.8	1.2	2.8-5.5	<10
Ni	125.9	64	107	74	92	126	117	42	74.2	60	53-70	109
Se	5.33	6	73.1	ND	20	8	15	12	140	20	<10	<10
Ag	1.17	1.8	4.1	ND	ND	ND	ND	ND	ND	ND	<0.5-0.6	<10
Tl	2.14	2	21.8	ND	ND	ND	ND	ND	0.5	3	<5	<10
V	865	846	1,020	830	1,480	630	780	920	576	800	770-880	918
Zn	842	12	58.0	920	320	310	7	3	3.5	3.5	<10	<10

*ERCO data from the homogeneity testing (Table 5).

**ERCO data from the preliminary effluent characterization (Table 6).

1,900 ug/L. Both contamination and methodological difficulties appear to be at fault. In fact, the spread of the values for Al was so large that no statistically significant effects could be established. Contamination appears also to have been a problem with Zn analyses and, to a lesser extent, with Ba and Fe.

REJECTION OF OUTLIERS

The analytical data supplied by the ten participating laboratories were processed by the IMVS program to remove spurious results.

The processing of the data involved three steps. First, the Youden's Laboratory Ranking Procedure (2) was used to detect and reject data having a large systematic error associated with a particular laboratory. Next, all zero, negative and non-detected data were rejected. Subsequently, the Thompson outlier test (6) was used to reject individual outliers.

Tables 11 through 16 tabulate the number of retained data points for each water type. The maximum number of retained data points for a Youden pair ampule is 10, achievable when all the data submitted by the ten participating laboratories for that ampule are deemed representative. Data rejection was not done indiscriminately, but was done in a manner which would remove only those data that would create non-representative summary statistics and not those data that are a result of some artifact of the analytical method. All rejected data are identified in Appendix C Raw Data tables by the symbol "*".

TABLE 11. NUMBER OF RETAINED DATA POINTS FOR LAB PURE WATER

Element	Youden Pair #1	Youden Pair #2	Youden Pair #3	Youden Pair #4	Youden Pair #5	Youden Pair #6	% Rejected
Al	7	7	7	7	7	7	30
Sb	7	7	8	7	8	8	25
As	7	8	8	7	8	8	23
Ba	8	8	8	8	8	8	23
Be	5	5	9	8	8	9	27
Cd	6	6	10	10	10	10	13
Cr	9	8	9	9	9	9	12
Co	9	9	9	9	9	9	10
Cu	9	9	8	9	9	8	13
Fe	9	8	8	8	9	9	15
Pb	7	7	7	7	8	7	28
Mn	6	5	9	9	9	9	22
Ni	10	10	9	10	10	10	2
Se	8	9	9	9	9	8	13
Ag	6	6	8	8	8	8	27
Tl	6	7	7	7	7	7	32
V	7	8	8	8	8	8	22
Zn	4	4	8	7	8	8	35

TABLE 12. NUMBER OF RETAINED DATA POINTS FOR DRINKING WATER

Element	Youden Pair #1	Youden Pair #2	Youden Pair #3	Youden Pair #4	Youden Pair #5	Youden Pair #6	% Rejected
Al	8	8	8	8	8	8	20
Sb	5	5	6	6	6	6	43
As	8	7	7	7	8	8	25
Ba	7	7	8	8	8	8	23
Be	7	4	8	8	7	8	30
Cd	7	8	8	7	7	8	25
Cr	8	9	8	9	8	8	17
Co	9	9	9	10	9	10	7
Cu	8	8	7	8	9	9	18
Fe	8	7	10	10	9	8	13
Pb	9	8	9	9	9	9	12
Mn	5	6	7	8	8	7	32
Ni	7	6	7	7	7	7	32
Se	9	9	9	9	9	9	10
Ag	6	5	9	9	9	9	22
Tl	8	7	8	8	8	8	22
V	10	10	9	9	9	9	7
Zn	4	4	5	5	7	7	47

TABLE 13. NUMBER OF RETAINED DATA POINTS FOR SURFACE WATER

Element	Youden Pair #1	Youden Pair #2	Youden Pair #3	Youden Pair #4	Youden Pair #5	Youden Pair #6	% Rejected
Al	7	8	8	4	7	6	33
Sb	8	6	8	8	8	7	25
As	9	8	9	9	8	9	13
Ba	8	8	9	9	9	9	13
Be	6	4	8	8	9	8	28
Cd	6	8	8	8	8	8	23
Cr	9	9	8	9	9	9	12
Co	9	9	9	9	9	9	10
Cu	8	9	9	9	9	9	12
Fe	5	7	8	8	9	7	27
Pb	8	7	8	8	8	8	22
Mn	3	0	4	6	7	5	58
Ni	9	8	9	9	9	8	13
Se	8	8	8	8	8	8	20
Ag	7	8	9	9	10	9	13
Tl	7	9	9	9	8	9	15
V	7	8	8	8	9	8	20
Zn	3	4	3	4	5	3	63

TABLE 14. NUMBER OF RETAINED DATA POINTS FOR EFFLUENT 1

Element	Youden Pair #1	Youden Pair #2	Youden Pair #3	Youden Pair #4	Youden Pair #5	Youden Pair #6	% Rejected
Al	7	7	8	7	8	8	25
Sb	6	7	8	8	7	8	27
As	8	8	8	8	8	8	20
Ba	9	8	9	9	9	9	12
Be	7	6	7	8	8	8	27
Cd	4	5	8	8	8	8	32
Cr	8	8	8	8	9	8	18
Co	8	8	8	7	8	8	22
Cu	9	9	8	9	9	8	13
Fe	10	9	9	10	10	10	3
Pb	7	7	9	9	9	8	18
Mn	9	9	9	9	9	9	10
Ni	7	6	6	6	6	7	37
Se	5	7	9	9	9	8	22
Ag	6	8	8	8	8	8	23
Tl	7	7	7	7	7	7	30
V	7	7	7	7	7	7	30
Zn	7	6	8	8	8	8	25

TABLE 15. NUMBER OF RETAINED DATA POINTS FOR EFFLUENT 2

Element	Youden Pair #1	Youden Pair #2	Youden Pair #3	Youden Pair #4	Youden Pair #5	Youden Pair #6	% Rejected
Al	8	8	7	8	6	8	25
Sb	7	7	8	7	8	8	25
As	7	7	8	8	8	8	23
Ba	8	7	8	9	9	9	17
Be	5	4	7	6	7	6	42
Cd	7	8	9	9	8	9	17
Cr	7	8	8	8	8	9	20
Co	8	8	8	7	8	8	22
Cu	7	8	8	8	8	8	22
Fe	8	6	8	7	9	9	22
Pb	8	8	7	8	8	8	22
Mn	9	8	8	9	9	8	15
Ni	9	9	9	9	9	8	12
Se	7	7	7	8	8	8	25
Ag	6	7	8	7	8	8	27
Tl	6	7	7	7	6	7	33
V	8	9	8	8	9	8	17
Zn	6	4	7	8	8	6	35

TABLE 16. NUMBER OF RETAINED DATA POINTS FOR EFFLUENT 3

Element	Youden Pair #1	Youden Pair #2	Youden Pair #3	Youden Pair #4	Youden Pair #5	Youden Pair #6	% Rejected
Al	8	8	9	8	7	8	20
Sb	4	6	8	8	8	8	30
As	7	6	9	9	9	9	18
Ba	7	7	6	7	7	5	35
Be	5	3	8	8	9	9	30
Cd	8	8	10	10	10	10	7
Cr	6	6	7	7	7	7	33
Co	8	7	8	6	7	6	30
Cu	6	4	9	9	9	9	23
Fe	8	9	9	9	9	9	12
Pb	7	7	7	7	7	7	30
Mn	3	4	7	8	9	9	33
Ni	6	4	8	7	7	7	35
Se	5	6	8	8	8	7	30
Ag	8	8	8	7	8	8	22
Tl	7	7	7	7	7	7	30
V	9	7	9	8	9	9	15
Zn	4	3	6	5	4	7	62

For the entire project, the IMVS program rejected 23% of the data. The percentage of rejected data did not vary significantly by water type. The lowest rejection was for laboratory-pure water for which 21% of the data was rejected; the highest, 27%, was for effluent 3.

For a single metal/water type, 63% of the data for zinc in surface water and 62% of the data for zinc in effluent 3 were rejected.

Data rejection by laboratory varied from 12% to 36% rejected and is presented in Table 17.

STATISTICAL SUMMARIES

Subsequent to the rejection of outlier and non-useable data, the IMVS program calculated several summary statistics on the remaining data base. These summary statistics are mean recovery, percent relative error, overall (i.e., precision associated with all laboratories) standard deviation, percent relative overall standard deviation, single-analyst standard deviation and percent relative single-analyst standard deviation.

To facilitate review and comparison of the summary statistics, percent relative error and percent overall relative standard deviation data have been compiled by water type in Tables 18-23. Included in these tables are mean values averaged by Youden pair concentration (increasing concentration from 1 to 6) and by element. A review of these tables yields the range of the accuracy (percent relative error) (0.13%-17,720%) and overall precision (overall percent relative standard deviation) (0.55%-171%) values for all the participating laboratories when analyzing a certain concentration of a given element in a given water type. Further review of these tables also indicates which elemental analyses in which water types yield poor accuracy and precision.

TABLE 17. PERCENTAGE OF DATA REJECTED FOR EACH LABORATORY

Laboratory Number	% Rejected
1	26
2	17
3	24
4	14
5	36
6	30
7	23
8	21
9	24
10	12

TABLE 18. ACCURACY AND PRECISION SUMMARY TABLE FOR LAB PURE WATER

Element		Youden Pair #1	Youden Pair #2	Youden Pair #3	Youden Pair #4	Youden Pair #5	Youden Pair #6	Average
Al	%Error-Acc	114.13	24.99	42.53	11.83	-11.52	-3.15	29.8
	%RSD-Prec	52.47	57.03	57.87	46.58	50.51	36.98	50.24
Sb	%Error-Acc	-41.56	-43.31	-25.88	-28.39	-14.27	-25.03	-29.74
	%RSD-Prec	44.22	53	36.93	19.2	36.46	46.46	39.37
As	%Error-Acc	-10.94	5.88	-10.26	-5.25	-5.86	-4.12	-5.09
	%RSD-Prec	15.61	44.13	5.87	8.65	23.56	11.7	18.25
Ba	%Error-Acc	33.37	36.21	1.21	.97	-5.24	-10.53	9.33
	%RSD-Prec	27.47	35.05	31.81	27.71	18.85	9.42	25.05
Be	%Error-Acc	-15.82	-5.56	-16.35	-10.08	-4.17	12.59	-6.56
	%RSD-Prec	15.86	77.69	18.36	17.52	17.22	20.68	27.88
Cd	%Error-Acc	13.19	12.94	-7.74	-9.14	-.45	.98	1.63
	%RSD-Prec	18.45	20.05	21.54	18.43	33.4	29.43	23.55
Cr	%Error-Acc	-3.13	-1.71	-12.47	-7.7	.61	-5.15	-4.92
	%RSD-Prec	23.23	8.72	25.44	13.2	7.65	14.32	15.42
Co	%Error-Acc	-10.38	-4.67	-10.43	-11.88	-12.03	-10.76	-10.02
	%RSD-Prec	15.68	13.45	24.19	24.18	21.25	26.2	20.82
Cu	%Error-Acc	-5.61	-4.72	-1.43	-4.86	-6.66	-3.61	-4.48
	%RSD-Prec	38.7	29.17	-4.3	20.07	53.96	10.14	24.62
Fe	%Error-Acc	146.44	27.68	71.36	36.14	4.92	51.34	56.31
	%RSD-Prec	92.3	61.07	60.08	15.44	14.15	39.57	47.1
Pb	%Error-Acc	-7.43	-6.28	-8.14	-15.02	-25.23	-13.68	-12.63
	%RSD-Prec	23.85	21.52	16.39	33.58	39.94	19.32	25.76
Mn	%Error-Acc	321.4	275.51	28.53	34.23	-13.17	-1.66	107.47
	%RSD-Prec	80.25	62.54	47.01	47.40	54.88	36.96	54.84
Ni	%Error-Acc	-18.36	-8.01	-15.5	-14.79	3.48	-5.79	-9.82
	%RSD-Prec	35.22	27.93	12.5	20.11	27.75	35.16	26.44
Se	%Error-Acc	10.65	7.64	1.09	1.39	-3.01	-4.27	2.24
	%RSD-Prec	16.92	44.53	10.62	14.6	19.8	18.21	20.78
Ag	%Error-Acc	34.43	24.37	-2.09	-4.74	-11.57	10.98	8.56
	%RSD-Prec	46.01	37.31	11.74	16.49	32.34	21.05	27.49
Tl	%Error-Acc	-9.76	-16.18	-10.77	-12.82	-12.42	-10.48	-12.07
	%RSD-Prec	11.13	13.52	8.1	12.63	12.39	10.84	11.43
V	%Error-Acc	-15.35	1.32	-28.4	-22.29	-15.3	-17.05	-16.17
	%RSD-Prec	14.1	20.51	48.3	47.99	43.05	37.05	35.16
Zn	%Error-Acc	455.04	209.00	423.97	189.16	172.57	84.91	255.78
	%PSD-Prec	51.52	68.63	82.76	141.81	95.96	82.07	87.12
Ave %Error-Acc by Youden Pair		55.01	20.72	23.30	7.05	2.26	2.54	
Ave %RSD-Prec by Youden Pair		34.61	38.66	26.62	30.31	33.5	28.08	

TABLE 19. ACCURACY AND PRECISION SUMMARY TABLE FOR DRINKING WATER

Element		Youden Pair #1	Youden Pair #2	Youden Pair #3	Youden Pair #4	Youden Pair #5	Youden Pair #6	Average
Al	%Error-Acc	132.59	152.61	64.47	64.69	56	29.17	83.25
	%RSD-Prec	29.88	61.71	29.35	55.86	24.61	29.71	38.52
Sb	%Error-Acc	24.18	41.1	-19.28	-9.2	-15.63	-15.55	.93
	%RSD-Prec	15.53	40.06	13.67	11.95	9.11	41.71	22
As	%Error-Acc	.71	-3.08	-10.89	-7.77	-4.22	-5.75	-5.16
	%RSD-Prec	17.95	33.18	10.18	12.21	17.06	16.27	17.8
Ba	%Error-Acc	58.35	50.66	4.4	-1.67	10.22	8.3	21.71
	%RSD-Prec	16.61	28.43	38.94	38.76	34.68	26.91	30.72
Be	%Error-Acc	.36	-21.47	-.38	-1.96	.13	-2.48	-4.79
	%RSD-Prec	30.35	29.92	21.95	12.23	16.64	14.42	20.91
Cd	%Error-Acc	46.62	18.84	6.46	-2.44	-15.35	-2.44	8.61
	%RSD-Prec	35.05	46.17	22.92	21.23	40.19	22.6	31.36
Cr	%Error-Acc	9.95	4.44	-6.24	5.62	3.5	-.46	2.8
	%RSD-Prec	39.52	51.73	13.58	24.21	10.96	8.37	24.72
Co	%Error-Acc	-14.22	-.82	3.58	1.94	-11.06	-24.13	-7.45
	%RSD-Prec	22.89	32.5	17.96	15.19	14.23	46.93	24.95
Cu	%Error-Acc	72.76	-16.6	-20.65	-11.34	16.64	1.77	12.62
	%RSD-Prec	69.68	43.14	36.98	49	36.15	21.33	42.71
Fe	%Error-Acc	130.23	-3.12	12.16	38.8	19.05	10.7	34.63
	%RSD-Prec	75.57	63.45	37.35	54.53	19.93	25.19	46
Pb	%Error-Acc	-7.57	-12.84	-15.88	-11.84	-14.04	-15.48	-12.94
	%RSD-Prec	42.32	48.26	26.65	16.6	23.28	28.55	30.94
Mn	%Error-Acc	259.06	277.93	-6.29	8.33	4.90	6.78	91.79
	%RSD-Prec	49.85	76.15	52.77	46.58	34.09	46.17	50.94
Ni	%Error-Acc	-23.83	-7.4	-26.57	-25.06	-11.44	-15	-18.21
	%RSD-Prec	27.73	46.72	33.48	37.96	16.25	21.35	30.58
Se	%Error-Acc	25.44	-5.4	3.82	4.29	6.61	10.66	7.57
	%RSD-Prec	40.42	45.71	19.79	20.15	16.11	17.1	26.54
Ag	%Error-Acc	223.44	36.04	-.37	-10.87	2.99	1.57	42.13
	%RSD-Prec	66.59	24.9	17.29	23.55	17.83	15.97	27.68
Tl	%Error-Acc	-18.33	-19.4	-8.46	-4.8	-11.27	-19.84	-13.68
	%RSD-Prec	14.76	12.3	20.82	17.15	29.34	31.49	20.97
V	%Error-Acc	-.91	-12.98	-16.53	-2.38	4.01	.64	-4.69
	%RSD-Prec	31.06	26.47	24.24	20.28	20.82	17.41	23.38
Zn	%Error-Acc	3603.36	726.67	409.02	145.93	306.17	315.68	917.80
	%RSD-Prec	82.66	124.44	89.88	85.93	134.63	103.00	103.42
Ave %Error-Acc by Youden Pair		251.228	68.80	20.52	10.01	19.28	15.79	
Ave %RSD-Prec by Youden Pair		39.35	46.40	29.32	31.29	28.65	29.69	

TABLE 20. ACCURACY AND PRECISION SUMMARY TABLE FOR SURFACE WATER

Element		Youden Pair #1	Youden Pair #2	Youden Pair #3	Youden Pair #4	Youden Pair #5	Youden Pair #6	Average
Al	%Error-Acc	306.63	344.4	70.38	-48.45	-1.71	12.91	114.02
	%RSD-Prec	103.19	117.3	84.05	80.3	43.85	46.77	79.24
Sb	%Error-Acc	-19.32	-34.12	-24.32	-29	-20	-7.71	-22.41
	%RSD-Prec	22.61	36.46	23.25	29.13	23.19	.55	22.53
As	%Error-Acc	-26.43	-17.2	-8.62	-7.1	-10.02	-14.43	-13.96
	%RSD-Prec	41.8	46.22	22.15	17.53	12.1	13.78	25.59
Ba	%Error-Acc	44.68	44.4	1.85	2.77	9.22	3.72	17.77
	%RSD-Prec	29.72	24.74	52.77	14.53	27.83	24.51	29.01
Be	%Error-Acc	11.02	5.24	-6.21	3.4	-16.18	-8.77	-1.91
	%RSD-Prec	18.83	10.2	18.76	17.93	46.83	17.52	21.67
Cd	%Error-Acc	-1.1	92.79	-10.19	-8.22	-6.05	16.67	13.98
	%RSD-Prec	48.18	97.36	25.65	24.13	23.88	42.63	43.63
Cr	%Error-Acc	-.49	-10.28	-13.64	-10.27	-7.78	-2.12	-7.43
	%RSD-Prec	22.25	26.9	27.23	51.44	11.85	14.27	25.65
Co	%Error-Acc	-4.16	1.53	-5.26	-8.44	-6.64	-7.54	-5.08
	%RSD-Prec	14.4	20.63	15.27	13.12	15.61	26.58	17.6
Cu	%Error-Acc	10.97	-16.76	1.07	-6.51	4.82	2.63	-.63
	%RSD-Prec	26	36.1	24.04	22.53	14.41	18.7	23.63
Fe	%Error-Acc	367.3	335.58	41.42	62	16.73	44.55	144.59
	%RSD-Prec	44.56	77.63	48.61	37.55	41.2	47.57	59.52
Pb	%Error-Acc	-7.36	-23.85	-16.85	-2.22	-14.67	-5.98	-11.82
	%RSD-Prec	35.22	36.13	17.34	29.97	13.1	20.43	25.36
Mn	%Error-Acc	962.64	UND	47.00	6.71	-5.98	11.02	204.28
	%RSD-Prec	32.87	UND	44.07	57.27	42.35	37.63	42.84
Ni	%Error-Acc	.04	-21.66	-19.25	-23.1	-11.97	-16.52	-15.41
	%RSD-Prec	52.95	51.56	29.62	22.49	19.22	9.82	30.94
Se	%Error-Acc	-.83	-9.29	-1.19	-10.76	4.27	4.93	-2.14
	%RSD-Prec	37.32	28.9	15.97	27.3	12.43	16.64	23.09
Ag	%Error-Acc	87.44	992.43	-8.84	-16.71	-20.71	-8.42	170.86
	%RSD-Prec	63.51	171	26.52	33.79	32.03	19.64	57.74
Tl	%Error-Acc	-26.16	-25.55	-16.27	-20.61	-21.18	-17.93	-21.28
	%RSD-Prec	24.51	23.19	19.91	25.77	20.63	23.02	22.83
V	%Error-Acc	-10.78	-13.33	-20.02	3.3	-6.18	-2.28	-8.21
	%RSD-Prec	15.11	14.02	12.68	21.83	13.74	12.8	15.03
Zn	%Error-Acc	602.74	2350.00	157.52	313.27	58.99	11.88	582.40
	%RSD-Prec	102.01	114.23	134.65	103.16	103.39	78.89	106.06
Ave %Error-Acc by Youden Pair		127.60	234.96	9.37	11.12	-3.06	0.92	
Ave %RSD-Prec by Youden Pair		40.83	48.96	35.69	34.98	28.75	26.21	

TABLE 21. ACCURACY AND PRECISION SUMMARY TABLE FOR EFFLUENT 1

Element		Youden Pair #1	Youden Pair #2	Youden Pair #3	Youden Pair #4	Youden Pair #5	Youden Pair #6	Average
Al	%Error-Acc	-12.43	-11.4	-4.87	3.04	4.17	11.61	-1.64
	%RSD-Prec	49.11	42.02	46.25	42.29	27.76	20.64	38.01
Sb	%Error-Acc	-19.05	-28.57	-10.66	-13.58	-16.89	-10.27	-16.5
	%RSD-Prec	61.03	62.42	41.99	21.61	7.42	21.09	35.92
As	%Error-Acc	126.17	74.97	35.89	41.54	10.96	9.72	49.87
	%RSD-Prec	27.6	42.72	10.42	12.93	25.49	22.72	23.64
Ba	%Error-Acc	93.15	128.1	47.98	44.74	18.85	-2.45	55.06
	%RSD-Prec	49.86	61.4	33.1	36.32	27.16	48.56	42.73
Be	%Error-Acc	2.41	22.02	-9.4	5.83	-9.09	-3.04	1.4
	%RSD-Prec	60.85	50.25	23.3	34.32	25.16	20.16	35.67
Cd	%Error-Acc	63.22	33.69	-19.34	-21.05	-15.07	-22	3.24
	%RSD-Prec	35.37	71.51	36.88	37.55	29.86	27.37	39.75
Cr	%Error-Acc	9.49	-20.59	-12.58	-6.9	-16.6	-9.12	-9.41
	%RSD-Prec	58.8	57.24	13.02	19.53	43.47	18.82	35.14
Co	%Error-Acc	4.23	5.54	-9.54	-3.4	-15.01	-10.35	-4.75
	%RSD-Prec	21.18	13.24	22.67	14.86	24.89	14.88	18.62
Cu	%Error-Acc	-5.29	-5.14	-1.56	-4.89	-6.73	-3.63	-4.54
	%RSD-Prec	38.62	29.02	4.49	20.1	53.98	10.15	26.06
Fe	%Error-Acc	-9.85	-9.52	-6.15	38.34	-.27	3.45	2.66
	%RSD-Prec	36.34	17.53	25.52	77.62	12.93	25.54	32.58
Pb	%Error-Acc	-8.78	7.28	-27.04	-19.76	-12.07	-8.54	-11.48
	%RSD-Prec	16.82	26.55	29.24	23.39	20.41	21.87	23.04
Mn	%Error-Acc	-11.18	-8.32	-1.45	-14.8	-2.87	-4.29	-7.15
	%RSD-Prec	47.7	48.1	19.94	37.64	18.06	18.33	31.62
Ni	%Error-Acc	-10.09	22.62	-19.37	-25.94	-38.83	-32.66	-17.37
	%RSD-Prec	41.75	18.59	27.78	16.67	10.78	21.78	22.89
Se	%Error-Acc	-41.72	29.43	-14.25	-15.07	-10.94	-15.21	-11.29
	%RSD-Prec	24.7	64.35	21.99	23.23	24.57	12.11	28.49
Ag	%Error-Acc	2.4	-7.71	-1.86	.91	-11.83	-10.35	-4.74
	%RSD-Prec	20.3	14.94	18.16	18.19	35.01	23.2	21.63
Tl	%Error-Acc	-33.11	-37.07	-28.4	-19.38	-23.78	-28.57	-28.38
	%RSD-Prec	33.11	24.95	20.75	35.95	34.7	28.43	29.64
V	%Error-Acc	-4.53	2.98	-7.9	11.33	5.16	5.91	2.15
	%RSD-Prec	29.47	21.24	26.27	30.28	18.75	24.38	25.06
Zn	%Error-Acc	-43.78	25.13	-33.76	-16.14	-46.92	-38.95	-25.73
	%RSD-Prec	83.21	61.91	71.63	74.1	80.7	70.21	73.62
Ave %Error-Acc by Youden Pair		5.62	12.41	-6.9	-.86	-10.44	-9.37	
Ave %RSD-Prec by Youden Pair		40.87	40.44	27.41	32.03	28.95	25.01	

TABLE 22. ACCURACY AND PRECISION SUMMARY TABLE FOR EFFLUENT 2

Element		Youden Pair #1	Youden Pair #2	Youden Pair #3	Youden Pair #4	Youden Pair #5	Youden Pair #6	Average
Al	%Error-Acc	4.06	14.65	-.75	-5.51	-5.89	-13.94	-1.23
	%RSD-Prec	40.67	39.13	27.46	28.38	9.53	19.99	27.52
Sb	%Error-Acc	19.21	38.76	-16.92	-31.86	-18.7	-18.26	-4.62
	%RSD-Prec	80.1	98.77	30.89	8.52	23.13	16.52	42.98
As	%Error-Acc	-10.53	-13.09	-12.42	-7.74	-12.11	4.23	-8.61
	%RSD-Prec	39.07	66.21	23.85	17.62	14.24	22.17	30.52
Ba	%Error-Acc	56.85	58.48	8.34	6.55	-5.65	-1.83	20.45
	%RSD-Prec	37.87	19.5	44.13	34.79	64.13	42.76	40.53
Be	%Error-Acc	-3.97	19.42	5.26	5.4	10.23	12.69	8.17
	%RSD-Prec	22.48	61.3	15.73	9.91	14.45	12.21	22.68
Cd	%Error-Acc	18.23	-4.06	-9.76	-21.68	-16.66	-15.69	-8.26
	%RSD-Prec	32.59	38.76	31.74	23.74	24.51	16.41	27.95
Cr	%Error-Acc	3.63	7.36	1.53	-16.86	-1.04	-.19	-.92
	%RSD-Prec	38.98	32.13	17.62	12.73	15.68	16.56	22.28
Co	%Error-Acc	5.69	-13.5	-4.25	-5.19	-3.99	-4.16	-4.23
	%RSD-Prec	19.91	21.75	14.86	9.55	17.22	11.57	15.81
Cu	%Error-Acc	-25.66	-17.53	-17.79	-7.06	-.36	-2.85	-11.87
	%RSD-Prec	12.99	15.66	25.02	14.64	13.65	8.07	15
Fe	%Error-Acc	9.67	9.42	4.14	-.78	-1.76	7.76	4.74
	%RSD-Prec	21.54	21.52	15.93	8.59	22.23	31.91	20.28
Pb	%Error-Acc	-25	-39.18	-17.52	-10.48	-17.65	-19.6	-21.57
	%RSD-Prec	47.68	39.48	16.64	17.29	30.28	26.84	29.7
Mn	%Error-Acc	-37.27	-16.84	-29.52	-41.26	-16.93	-10.01	-25.3
	%RSD-Prec	27.36	19.52	9.12	57.38	40.51	12.75	27.77
Ni	%Error-Acc	-26.93	-36.4	-22.34	-22.61	-3.95	-16.38	-21.43
	%RSD-Prec	42.98	63.36	22.6	25.1	34.44	21.63	35.01
Se	%Error-Acc	1.85	-30.43	15.05	2.59	8.95	5.27	.54
	%RSD-Prec	50.58	55.07	17.02	20.18	21.74	23.1	31.28
Ag	%Error-Acc	-57.53	-42.32	-46.53	-55.14	-54.91	-51.27	-51.28
	%RSD-Prec	73.38	67.25	63.2	69.02	67.04	68.11	68
Tl	%Error-Acc	-45.35	-50.35	-37.55	-33.49	-44.59	-36.81	-41.37
	%RSD-Prec	41.36	42.66	7.93	18.13	12.13	25.96	24.69
V	%Error-Acc	-12.8	-22.15	-16.93	-6.78	-7.45	-8.2	-12.38
	%RSD-Prec	6.02	43.4	17.91	14.3	24.8	9	19.23
Zn	%Error-Acc	49.61	1.22	113.27	-4.08	4.79	-26.55	23.04
	%RSD-Prec	58.56	72.6	95.3	46.49	66.17	85.96	70.84
Ave %Error-Acc by Youden Pair		-4.23	-7.58	-4.7	-14.22	-10.42	-10.87	
Ave %RSD-Prec by Youden Pair		38.56	45.44	27.6	24.24	28.66	26.19	

TABLE 23. ACCURACY AND PRECISION SUMMARY TABLE FOR EFFLUENT 3

Element		Youden Pair #1	Youden Pair #2	Youden Pair #3	Youden Pair #4	Youden Pair #5	Youden Pair #6	Average
Al	%Error-Acc	118.14	123.75	35.72	42.83	27.14	56.54	67.35
	%RSD-Prec	56.49	50.36	54.73	44.43	8.76	44.28	43.17
Sb	%Error-Acc	-22.38	-51.78	-49.98	-36.53	-40.22	-28.08	-38.16
	%RSD-Prec	65.12	31.53	47.84	29.08	24.55	32.51	38.43
As	%Error-Acc	-22.76	-9.68	-19.53	-11.54	-11.75	-10.34	-14.26
	%RSD-Prec	43	43.8	25.2	20.16	15.44	14.57	27.02
Ba	%Error-Acc	63.6	17.37	-52.24	-43.69	-43.18	-60.14	-19.71
	%RSD-Prec	32.99	48.83	44.72	70.87	60.21	7.11	44.12
Be	%Error-Acc	-13.5	-12.95	-19.16	-5.74	-4.24	-8.33	-10.65
	%RSD-Prec	63.25	21.91	17.61	19.43	29.25	15.38	27.8
Cd	%Error-Acc	24.43	1.22	.76	-7.31	-2.22	1.95	3.13
	%RSD-Prec	62.31	28.7	24.49	35.8	29.96	29.28	35.09
Cr	%Error-Acc	-8.81	-22.48	-9.25	-2.13	-14.58	-6.42	-10.61
	%RSD-Prec	23.31	28.98	29.55	30.74	20.74	9.27	23.76
Co	%Error-Acc	-8.02	-20.96	-14.51	-12.55	-23.91	-16.82	-16.12
	%RSD-Prec	19.64	21.16	10.41	9.93	27.89	13.49	17.08
Cu	%Error-Acc	-3.63	-26.71	-21.89	-27.35	-16.72	-6.89	-17.19
	%RSD-Prec	87.33	78.39	55.4	32.2	21.21	29.08	50.6
Fe	%Error-Acc	156.5	139.2	6.69	4.33	37.55	32.56	62.8
	%RSD-Prec	75.33	84.53	30.89	36.98	44.34	47.87	53.32
Pb	%Error-Acc	-15.26	-21.25	-18.65	-9.18	-41.5	-38.1	-23.99
	%RSD-Prec	57.24	53.38	33.4	35.88	24.54	52.29	42.78
Mn	%Error-Acc	192.40	699.76	9.71	-15.37	-12.28	-16.86	142.89
	%RSD-Prec	3.46	114.41	45.11	25.99	34.08	26.66	41.62
Ni	%Error-Acc	-61.07	-42.76	-14.93	-20	-22.23	-22.31	-30.55
	%RSD-Prec	100.9	80.8	38.53	15.37	14.99	13.8	44.06
Se	%Error-Acc	-22.41	-46.33	-27.93	-22.93	-15.1	-7.96	-23.77
	%RSD-Prec	69.83	84.83	58.42	55.47	27.89	29.97	54.4
Ag	%Error-Acc	7.09	17.09	12.52	-5.55	-21.04	-41.35	-5.2
	%RSD-Prec	23.01	30.06	35.31	33.35	41.51	26.85	31.68
Tl	%Error-Acc	-35.67	-34.46	-18.4	-17.26	-22.61	-23.62	-25.33
	%RSD-Prec	24.27	22.92	17.77	14.87	20.14	23.4	20.56
V	%Error-Acc	-16.74	-13.24	-6.39	-3.77	-5.78	-5.53	-8.57
	%RSD-Prec	19.1	4.54	14.45	8.09	18.64	22.23	14.5
Zn	%Error-Acc	4773.29	17719.62	570.60	1805.08	109.59	503.76	4246.99
	%RSD-Prec	90.57	137.18	90.56	90.44	81.47	124.69	102.48
Ave %Error-Acc by Youden Pair		283.61	1023.09	20.18	89.53	-6.83	16.78	
Ave %RSD-Prec by Youden Pair		50.95	53.68	37.47	33.84	30.30	31.26	

REGRESSION EQUATIONS

The IMVS code regresses overall precision and single analyst precision against the mean recovery of a particular element in a given water type and regresses accuracy against the true concentration. The resulting output (refer to Section 2, Table 1) includes the slopes and the intercepts of the straight lines which best approximate the functional relationship between the values.

For laboratory-pure water (Table 18) which contained minimal background levels of the 18 metals, the average percent relative error decreases as spike concentrations increase. A larger average relative error exists for the low Youden pairs (1 and 2) than exists for the high concentration pairs (5 and 6). This trend is as expected; i.e., analyses at or near the detection limit are less accurate. However, for certain specific elements (Ag, Cd, Ni) the relative error is lowest for the medium concentration spikes, possibly indicating that the high Youden pairs were analyzed above the upper limit of the linear range. The corresponding trend (dependence on concentration) for precision is less pronounced but for all waters the average percent relative standard deviation is highest for the low Youden pairs and generally lowest for the high Youden pairs.

EFFECTS OF WATER TYPE

The multiplicative model (Equation 10) discussed in Section 4 was fitted separately to the data for each element to test for effects due to water type. The detailed analysis of variance tables and the 95% confidence limits for the slopes and intercepts are presented with the raw data in Appendix C. The elements showing statistically significant differences by water type are summarized in Table 24.

Table 24. EFFECT OF WATER TYPE

Element	Water Type	Observed F-Value	$P(F>F_{obs})$	F Test Statistically Significant at the 95% Level	Significant Effect Established at the 95% CI		Practical Importance Established
					Slope	Intercept	
As	Effluent 2	14.78	0.0000	yes	yes	yes	yes
	Effluent 3	14.78	0.0000	yes	no	yes	yes
Be	Surface	3.02	0.0207	yes	yes	yes	yes
Cu	Effluent 2	7.89	0.0007	yes	yes	yes	no
Fe	Surface	6.74	0.0001	yes	yes	yes	no
	Effluent 2	9.72	0.0001	yes	yes	yes	no
Mn	Effluent 1	7.60	0.0009	yes	yes	yes	no
Ni	Effluent 2	13.35	0.0000	yes	yes	yes	yes
	Effluent 3	13.35	0.0000	yes	yes	yes	yes
Se	Effluent 1	6.33	0.0000	yes	no	yes	yes
	Effluent 3	6.33	0.0000	yes	yes	yes	yes
[illegible]	Effluent 2	15.17	0.0000	yes	no	yes	yes
Tl	Surface	6.00	0.0002	yes	no	yes	yes
	Effluent 2	6.88	0.0009	yes	no	yes	yes
Zn	Effluent 3	14.73	0.0000	yes	yes	yes	no

In order to determine if any of the statistically significant effects were of practical importance, the summary statistics and raw data were reviewed. A discussion of the summary statistics by element follows:

Arsenic - The mean recoveries for effluents 2 and 3 are lower than for lab pure water or effluent 1. In fact, the percent relative errors for lab pure water and effluent 1 are positive (high recoveries) while the percent relative errors for effluents 2 and 3 are negative (low recoveries). The overall standard deviations and single-analyst standard deviations show no clear differences between water type indicating no practical difference in precision. The accuracy, however, does appear to be matrix dependent.

Beryllium - The 95% confidence limit for the slope of the regression line for surface water does not contain zero. This indicates a statistically significant difference that may be concentration-dependent. An examination of the raw data for the low Youden Pair for lab pure water and surface water shows that 50% of the data points were rejected and that 17 out of 40 of these were reported as "less than" values implying that the concentration dependent effect may be that the low spikes were too close to the method detection limit. The method detection limit was not achieved in 17 instances and is most likely too optimistic. The overall standard deviation and single-analyst standard deviation for all six water types were generally large and were larger for the low spike pairs.

Copper - Effluent 2 had a statistically significant effect established by the confidence limit for the slope again indicating the possibility of a concentration dependent effect. The background concentration of copper in effluent 2 (from the

homogeneity test data) was approximately 200 ug/L which is near the upper limit of the linear range of the method. Consequently, spiking levels for effluent 2 were dramatically different from levels for all other waters and multiple dilutions would have been necessary for the high spikes.

The single-analyst relative deviation for the high Youden pair spikes however show better precision (3.5%) for effluent 2 than for the lab pure water (12.9%) and the percent relative error for the high pair indicates better accuracy for effluent 2 than for the spiked lab pure water. The percent relative error and single-analyst percent relative standard deviations are reversed for the low spikes i.e. analysis of the lab pure water was more accurate and more precise than for effluent 2 due to the high copper background concentration in effluent 2. This most likely indicates no practical importance to the statistical difference for effluent 2.

Iron - The surface waters and effluent 2 both had significant slope and intercept differences from lab pure water. Given the range of values for the percent relative standard deviation (8.59% to 92.3%) the percent relative error (-25.2% to +367%) and single-analyst errors (5.5% to 76.8%) it is doubtful that any practical significance may be attached to the differences. Although there is insufficient evidence to support any conclusion, random contamination of the samples is highly possible for an analyte as ubiquitous as iron.

Manganese - The data for manganese exhibited several unusual effects. The recoveries for the low Youden pairs for lab pure water, surface water, drinking water, and

effluent 3 were extremely high and 60% of these data points were rejected as outliers. These waters contained no detectable background levels of manganese and consequently the low spikes were near the reported method detection limit. The accuracy and precision as well as the high data rejection all suggest that the published detection limit is too low.

In addition, effluent 1 had significant slope and intercept differences from lab pure water. An examination of the raw data and summary statistics reveals that for one low spike of the lab pure water the percent relative error was 135.7% while for all other spikes the percent relative error was below 15%. The raw data seem to indicate that the concentration in the spiking solution was in error by a factor of two or that the amount of solution spiked was in error (i.e., an error in the spiking instructions). However, all ampules analyzed during the homogeneity study gave the correct concentration and the ampule contained four other elements which would have also exhibited a factor of two error if the spiking instructions were at fault. In addition, the same ampule was used to spike the effluent with a percent relative error of 11.18%. The ampules for the Youden pair in question are designated 4a and 4b in Table 9 with 4a being the "incorrect" concentration. It is doubtful that the statistically significant difference has any practical importance.

Nickel - Both effluents 2 and 3 exhibited low recovery and extremely high percent relative standard deviations particularly at the low spike levels. For effluent 3 the low spike levels were less than the background concentration, 50% of the data was rejected, and poor precision is not

surprising. All other spike levels are well above the background concentrations and the statistically significant differences are probably of practical importance.

Selenium - Both effluents 1 and 3 exhibited consistently low recoveries and poor precision, therefore the statistically significant differences are of practical importance.

Silver - Effluent 2 was a silver containing photographic industry waste. The average recoveries were only 50% at all spike levels and the percent relative standard deviations were above 60%. The method did not work well for this matrix. In fact, in Tables 6 and 7 where the homogeneity data and ICAP data are summarized, the furnace AA values for the silver content of effluent 2 ranged from 4.6 to 7.6 ug/L while the ICAP value was 62 ug/L.

Thallium - Recoveries of thallium were consistently low for all water types at all spike levels. Surface water and effluent 2 had significant differences in intercept, indicative of a concentration independent effect of practical importance. Observation of the raw data reveals that the method is also subject to systematic error. Laboratories 3 and 6 had over 70% of their data points rejected as outliers.

Zinc - Effluent 3 showed a statistically significant difference in both slope and intercept when compared to lab pure water. However, the scatter in the data is so large at the spike levels used (ca. 0.5, 5, and 15 ug/L) it is doubtful that there is any practical importance to the difference. The percent relative errors for both lab pure water and effluent 3 were all positive errors and ranged from 84.8% to 17,719%. Less than half the data was retained for the

low spike pairs. The data strongly suggests environmental contamination of the samples during digestion or analysis.

For eight of the elements, no statistically significant differences from laboratory-pure water were found for the other waters or effluents. It should not be assumed that the furnace methods worked well for these elements. In fact there are four reasons for finding no significant differences:

1. There are none - the methods work well for all matrices for a particular element.

2. There were universally low recoveries for all matrices for a particular element.

3. There were universally high recoveries for all matrices for a particular element.

4. The method worked so badly or was subject to such large random error that, statistically, nothing could be proven.

These eight elements are discussed below.

Aluminum - All data were erratic regardless of the matrix. In fact more laboratory-pure water data were rejected than were effluent 3 data. For a low spike into laboratory-pure water (at 28 ug/L) values were reported from not detected to 4940 ug/L. Aluminum requires high atomization temperatures in furnace AAS and is sensitive to temperature fluctuations as well as to the condition of the graphite. These effects as well as random contamination or carry-over made it impossible to discern any effects related to matrix (water type) or concentration.

Antimony - All recoveries were low for this element regardless of water type and the overall precision rather poor (20-40% RSD). In addition, certain laboratories had large amounts of data rejected; i.e., experienced difficulties with antimony analysis. All data for laboratory 5 were rejected; over 50% of all data for laboratory 7 and over 70% of all low spikes for laboratories 4 and 8 were rejected.

Barium - Most water types had a low data rejection for barium. Recoveries for low spikes were generally high and for high spikes slightly low except for effluent 3. For effluent 3 the medium and high spikes experienced very low recoveries; in fact so many laboratories achieved low recoveries for these spikes that laboratories achieving the "true" value were rejected.

Cadmium - The method worked well for cadmium in all water types. Almost all of the rejected data were low spikes near the method detection limit and overall, only approximately 10% of the data points were rejected. The (photographic) effluent 2 had a slight (8%) bias toward low recoveries which may be indicative of a slight problem with the complexing agents which severely affected silver analyses in this water type.

Chromium - The method generally worked well for chromium. Of the data rejected, almost half came from laboratory 6.

Cobalt - The method generally worked well for cobalt. Data rejection was higher for the effluents than for the surface and drinking waters but only slightly higher.

Lead - Most of the data rejected for lead were high spikes and recoveries for high spikes were low. This may indicate that analyses were being performed outside the linear range.

Vanadium - For the retained data, recoveries of vanadium were slightly low. However, all rejected data points were high values, i.e., above the "true" concentration. Only in effluent 3 (which contained significant background levels of vanadium) were low data points rejected.

REFERENCES

1. Methods for Chemical Analysis of Water and Wastes, EPA 600-4/79-020, U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio, March 1979.

2. Youden, W.J. Statistical Techniques for Collaborative Test, Association of Official Analytical Chemist, Washington, D.C., 1979.

3. Outler, E.C. and McCreery, J. H., Interlaboratory Method Validation Study: Program Documentation. Battelle Columbus Laboratories, 1982.

4. Sokal, R.R. and Rohlf, F.J., Biometry, W.H. Freeman and Co., San Francisco, 1969.

5. Annual Book of ASTM Standards, Part 31. American Society for Testing and Material, Philadelphia, Pennsylvania.

6. Thompson, W.R., Annals of Mathematical Statistics, Vol. 6, 1935, p. 214.

7. Draper, N.R. and Smith H., Applied Regression Analysis, 2nd Edition, John Wiley and Sons, New York, 1981.

8. Bishop, T., Brydon, F. and Outler, E.C., Battelle Report for EPA contract 68-03-2624, Development of Statistical Technique to Compare Analytical Methods Across Wastewaters.

APPENDIX A

SAMPLE INSTRUCTIONS SUPPLIED TO LABORATORIES

NOTICE!! PLEASE READ INSTRUCTIONS BEFORE UNPACKING

The ampules contained in this package are packed in vermiculite. Please be careful when removing the vermiculite that ampule necks are not broken.

Ampules are placed in order corresponding to that on the packing list. It will make your life easier to remove them in order according to the list.

Packing List - Shipment consists of 3 boxes

1. 1 set instructions - Box 1
2. 2 1-gallon containers for Effluent 1 - Box 2
3. 2 1-gallon containers for Effluent 2 - Box 2
4. 2 1-gallon containers for Effluent 3 - Box 3
5. 1 10-ml of NBS SRM 1643a with certified values - Box 1
6. Spike Ampules - Box 1

Effluent Description	Spike Designation	Ampule Identification	Total # of Ampules
Lab-pure water	LP-1-A	LP-1-A-1 to LP-1-A-5	5
Lab-pure water	LP-1-B	LP-1-B-1 to LP-1-B-5	5
Lab-pure water	LP-2-A	LP-2-A-1 to LP-2-A-5	5
Lab-pure water	LP-2-B	LP-2-B-1 to LP-2-B-5	5
Lab-pure water	LP-3-A	LP-3-A-1 to LP-3-A-2	2
Lab-pure water	LP-3-B	LP=3-B-1 to LP-3-B-2	2
Lab-pure water	LP-4-A	LP-4-A-1 to LP-5-A-5	5
Lab-pure water	LP-4-B	LP-4-B-1 tp LP-4-B-5	5
Lab-pure water	LP-5-A	LP-5-A-1 to LP-5-A-2	2
Lab-pure water	LP-5-B	LP-5-B-1 to LP-5-B-2	2
Lab-pure water	LP-6-A	LP-6-A-1 to LP-6-A-2	2
Lab-pure water	LP-6-B	LP-6-B-1 to LP-6-B-2	2
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Effluent Description	Spike Designation	Ampule Identification	Total # of Ampules
Drinking water	DW-1-A	DW-1-A-1 to DW-1-A-2	2
Drinking water	DW-1-B	DW-1-B-1 to DW-1-B-2	2
Drinking water	DW-2-A	DW-2-A-1 to DW-2-A-2	2
Drinking water	DW-2-B	DW-2-B-1 to DW-2-B-2	2
Drinking water	DW-3-A	DW-3-A-1 to DW-3-A-2	2
Drinking water	DW-3-B	DW-3-B-1 to DW-3-B-2	2
			12
Surface water	SW-1-A	SW-1-A-1 to SW-1-A-2	2
Surface water	SW-1-B	SW-1-B-1 tp SW-1-B-2	2
Surface water	SW-2-A	SW-2-A-1 to SW-2-A-2	2
Surface water	SW-2-B	SW-2-B-1 tp SW-2-B-2	2
Surface water	SW-3-A	SW-3-A-1 to SW-3-A-2	2
Surface water	SW-3-B	SW-3-B-1 tp SW-3-B-2	2
			12
Effluent 1	E1-1-A	E1-1-A-1 to E1-1-A-3	3
Effluent 1	E1-1-B	E1-1-B-1 to E1-1-B-3	3
Effluent 1	E1-2-A	E1-2-A-1 to E1-2-A-3	3
Effluent 1	E1-2-B	E1-2-B-1 to E1-2-B-3	3
Effluent 1	E1-3-A	E1-3-A-1 to E1-3-A-3	3
Effluent 1	E1-3-B	E1-3-B-1 to E1-3-B-3	3
			18
Effluent 2	E2-1-A	E2-1-A-1 to E2-1-A-3	3
Effluent 2	E2-1-B	E2-1-B-1 to E2-1-B-3	3
Effluent 2	E2-2-A	E2-2-A-1 to E2-2-A-3	3
Effluent 2	E2-2-B	E2-2-B-1 to E2-2-B-3	3
Effluent 2	E2-3-A	E2-3-A-1 to E2-3-A-3	3
Effluent 2	E2-3-B	E2-3-B-1 to E2-3-B-3	3
			18

Effluent Description	Spike Designation	Ampule Identification	Total # of Ampules
Effluent 3	E3-1-A	E3-1-A-1 to E3-1-A-3	3
Effluent 3	E3-1-B	E3-1-B-1 to E3-1-B-3	3
Effluent 3	E3-2-A	E3-2-A-1 to E3-2-A-3	3
Effluent 3	E3-2-B	E3-2-B-1 to E3-2-B-3	3
Effluent 3	E3-3-A	E3-3-A-1 to E3-3-A-3	3
Effluent 3	E3-3-B	E3-3-B-1 to E3-3-B-3	3
			18

1. INTRODUCTION

The purpose of this study is to define the precision and accuracy of approved atomic absorption furnace procedures for the analysis of 18 metals in effluent and water samples. The 18 metals of interest are aluminum (Al), antimony (Sb), arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), manganese (Mn), nickel (Ni), selenium (Se), silver (Ag), thallium (Tl), vanadium (V), and zinc (Zn). Samples are to be prepared and analyzed using digestion methods and instrumental methods specified by EPA (1979).[a]

Analyses are to be performed on the three effluent samples supplied by ERCO and three water samples supplied by subcontractor laboratories (a laboratory-pure water sample, a finished drinking water sample, and a surface water sample). Samples are to be prepared for analysis using spike solutions contained in the enclosed package.

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[a]"Methods for Chemical Analysis of Water and Wastes," EPA 600-4/79-020, U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio, March 1979.

2. ANALYTICAL PROCEDURES

2.1 Preliminary Steps

2.1.1 Verification of Package Contents

The three effluent samples and spike ampules are contained in the enclosed package. An itemized list of the package contents is enclosed. Each ampule contains an identification number and a serial number. Please verify that the package contents are correct and complete by checking against the packing list. Also record the serial number and identification number for each ampule.

2.1.2 Collection of lab-pure, drinking, and surface water samples

Each participating laboratory is responsible for collection of the following types of water for use in the study:

1) laboratory-pure water (distilled or deionized water equivalent to ASTM Type I or Type II reagent water)[a]
2) finished drinking water
3) surface water vulnerable to contamination

Samples should be collected using appropriate methods and preserved immediately upon collection. Preservation methods should be those specified by EPA.[b] Collect sufficient

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[a]"Annual Book of ASTM Standards," Part 31. American Society for Testing and Material, Philadelphia, Pennsylvania.

[b]"Methods for Chemical Analysis of Water and Wastes," EPA 600-4/79-020, U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio, March 1979.

quantity of sample that the same material can be used for the entire study. It is suggested that at least two gallons of each water type be collected.

2.2 Preparation of Test Sample

Spike ampules are enclosed for each of the sample types to be utilized in the study. The lab-pure water is to be spiked at 6 concentration levels with each level consisting of 2 spikes prepared as a Youden Pair (similar but distinctly different concentrations). All other sample types are to be spiked at 3 levels with each level consisting of a Youden Pair. Please note that each spike level may consist of more than one ampule. A summary of the study design with appropriate identifying information is presented in Table 1. The ampules which comprise each spike are identified in Table 2.

Each water and effluent sample should be dosed with spike solutions according to the following instructions:

1. Remove a 200-ml aliquot of the sample and place in appropriate container.
2. Remove a 10-ml aliquot from each spike ampule specific for that spike level and add to sample.
3. Cap and shake vigorously for 30 seconds.
4. Allow sample to remain unshaken for 5 minutes, then shake vigorously for an additional 30 seconds.
5. Store at room temperature in a dark place for 7 days. Be sure to label sample with appropriate identification.
6. Adjust pH to <2 with 1:1 nitric acid.
7. Cap and refrigerate for 24 hours.
8. Remove aliquots for analysis.

Table 1.—Summary of test design and identification information

Sample Type	Spike Level	Youden Pairs	Spike Designation
Lab-pure water (LP)	0	None	Background
	1	A and B	LP-1-A, LP-1-B
	2	A and B	LP-2-A, LP-2-B
	3	A and B	LP-3-A, LP-3-B
	4	A and B	LP-4-A, LP-4-B
	5	A and B	LP-5-A, LP-5-B
	6	A and B	LP-6-A, LP-6-B
Drinking water (DW)	0	None	Background
	1	A and B	LP-1-A, LP-1-B
	2	A and B	LP-2-A, LP-2-B
	3	A and B	LP-3-A, LP-3-B
Surface water (SW)	0	None	Background
	1	A and B	SW-1-A, SW-1-B
	2	A and B	SW-2-A, SW-2-B
	3	A and B	Sw-3-A, SW-3-B
Effluent 1 (E1)	0	None	Background
	1	A and B	E1-1-A, E1-1-B
	2	A and B	E1-2-A, E1-2-B
	3	A and B	E1-3-A, E1-3-B
Effluent 2 (E2)	0	None	Background
	1	A and B	E2-1-A, E2-1-B
	2	A and B	E2-2-A, E2-2-B
	3	A and B	E2-3-A, E2-3-B
Effluent 3 (E3)	0	None	Background
	1	A and B	E3-1-A, E3-1-B
	2	A and B	E3-2-A, E3-2-B
	3	A and B	E3-3-A, E3-3-B

Table 2.—Summary of ampules to be used for each spike

Effluent Description	Spike Designation	Ampule Identification	Total # of Ampules
Lab pure water	LP-1-A	LP-1-A-1 to LP-1-A-5	5
Lab-pure water	LP-1-B	LP-1-B-1 to LP-1-B-5	5
Lab-pure water	LP-2-A	LP-2-A-1 to LP-2-A-5	5
Lab-pure water	LP-2-B	LP-2-B-1 to LP-2-B-5	5
Lab-pure water	LP-3-A	LP-3-A-1 to LP-3-A-2	2
Lab-pure water	LP-3-B	LP=3-B-1 to LP-3-B-2	2
Lab-pure water	LP-4-A	LP-4-A-1 to LP-5-A-5	5
Lab-pure water	LP-4-B	LP-4-B-1 tp LP-4-B-5	5
Lab-pure water	LP-5-A	LP-5-A-1 to LP-5-A-2	2
Lab-pure water	LP-5-B	LP-5-B-1 to LP-5-B-2	2
Lab-pure water	LP-6-A	LP-6-A-1 to LP-6-A-2	2
Lab-pure water	LP-6-B	LP-6-B-1 to LP-6-B-2	2
			42
Drinking water	DW-1-A	DW-1-A-1 to DW-1-A-2	2
Drinking water	DW-1-B	DW-1-B-1 to DW-1-B-2	2
Drinking water	DW-2-A	DW-2-A-1 to DW-2-A-2	2
Drinking water	DW-2-B	DW-2-B-1 to DW-2-B-2	2
Drinking water	DW-3-A	DW-3-A-1 to DW-3-A-2	2
Drinking water	DW-3-B	DW-3-B-1 to DW-3-B-2	2
			12
Surface water	SW-1-A	SW-1-A-1 to SW-1-A-2	2
Surface water	SW-1-B	SW-1-B-1 tp SW-1-B-2	2
Surface water	SW-2-A	SW-2-A-1 to SW-2-A-2	2
Surface water	SW-2-B	SW-2-B-1 tp SW-2-B-2	2
Surface water	SW-3-A	SW-3-A-1 to SW-3-A-?	2
Surface water	SW-3-B	SW-3-B-1 tp SW-3-B-2	2
			12

Table 2.—Continued

Effluent Description	Spike Designation	Ampule Identification	Total # of Ampules
Effluent 1	E1-1-A	E1-1-A-1 to E1-1-A-3	3
Effluent 1	E1-1-B	E1-1-B-1 to E1-1-B-3	3
Effluent 1	E1-2-A	E1-2-A-1 to E1-2-A-3	3
Effluent 1	E1-2-B	E1-2-B-1 to E1-2-B-3	3
Effluent 1	E1-3-A	E1-3-A-1 to E1-3-A-3	3
Effluent 1	E1-3-B	E1-3-B-1 to E1-3-B-3	3
			18
Effluent 2	E2-1-A	E2-1-A-1 to E2-1-A-3	3
Effluent 2	E2-1-B	E2-1-B-1 to E2-1-B-3	3
Effluent 2	E2-2-A	E2-2-A-1 to E2-2-A-3	3
Effluent 2	E2-2-B	E2-2-B-1 to E2-2-B-3	3
Effluent 2	E2-3-A	E2-3-A-1 to E2-3-A-3	3
Effluent 2	E2-3-B	E2-3-B-1 to E2-3-B-3	3
			18
Effluent 3	E3-1-A	E3-1-A-1 to E3-1-A-3	3
Effluent 3	E3-1-B	E3-1-B-1 to E3-1-B-3	3
Effluent 3	E3-2-A	E3-2-A-1 to E3-2-A-3	3
Effluent 3	E3-2-B	E3-2-B-1 to E3-2-B-3	3
Effluent 3	E3-3-A	E3-3-A-1 to E3-3-A-3	3
Effluent 3	E3-3-B	E3-3-B-1 to E3-3-B-3	3
			18

Table 4.—Method references for graphite furnace analysis

Element	Method Reference[a]
Al	202.2
Sb	204.2
As	206.2
Ba	208.2
Be	210.2
Cd	213.2
Cr	218.2
Co	219.2
Cu	220.2
Fe	236.2
Pb	239.2
Mn	243.2
Ni	249.2
Se	270.2
Ag	272.2
Tl	279.2
V	286.2
Zn	289.2

[a]Methods for Chemical Analysis of Water and Wastes, EPA 600-4/79-020, U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio, March 1979.

Table 3.—Summary of analyses to be conducted for method validation study

Analysis type	Sample type	# of spikes	# of elements	Total number of analyses[a]
Background	Lab-pure water	0	18	18
Background	Drinking water	0	18	18
Background	Surface water	0	18	18
Background	Effluent 1	0	18	18
Background	Effluent 2	0	18	18
Background	Effluent 3	0	18	18
Spike	Lab-pure water	12	18	216
Spike	Drinking water	6	18	108
Spike	Surface water	6	18	108
Spike	Effluent 1	6	18	108
Spike	Effluent 2	6	18	108
Spike	Effluent 3	6	18	108
				864

[a]An analysis is the determination of one element in one sample

INTERLABORATORY METHOD STUDY

Data Reporting Form

Laboratory Number: _____

Spike Designation: _____

Concentration (µg/l)

Element	Total	Background	Difference
Al			
Sb			
As			
Ba			
Be			
Cd			
Cr			
Co			
Cu			
Fe			
Pb			
Mn			
Ni			
Se			
Ag			
Tl			
V			
Zn			

4. DATA REPORTING REQUIREMENTS

Data generated during the actual method study will be due within 45 days of sample receipt. All data must be reported to ERCO on standardized report forms enclosed with this package. For each spiked sample, the total and background concentrations must be reported as well as the difference.

Quality control data generated during each analytical run must be reported for each element. The quality control/quality assurance requirements are summarized in Section 3. Quality control data are to be reported on the enclosed forms.

The final volumes of water and effluent samples will vary according to the number of ampules that must be added. No correction or dilution is necessary to account for this since these factors were compensated for during the ampule preparation.

A background sample (unspiked aliquot) should be removed from each water and effluent sample. This aliquot should be preserved and stored in the same manner as spiked samples.

2.3 Procedures for Sample Digestion

A sample must be digested prior to instrumental analysis. Procedures for sample digestion are specified in Section 4.1.3 of EPA (1979) as modified for determinations of antimony, arsenic, and selenium by Methods 204.2, 206.2, and 270.2, respectively.

2.4 Procedures for Instrumental Analysis

Instrumental analyses will be performed using conditions and methods specified by EPA (1979) and the instrument manufacturer. Applicable method references are summarized in Table 3.

The number and types of samples to be analyzed for the method validation study are summarized in Table 4. A total of 48 samples (exclusive of blanks, duplicates, and quality control spikes) must be prepared and analyzed. Six of these samples will be background analyses of laboratory-pure water, drinking water, surface water, and the three effluents. Twelve of the samples will be spiked laboratory-pure water samples. The remaining 30 samples will be composed of six spiked drinking samples, six spiked surface water samples, and 18 spiked effluent samples (6 spikes per effluent).

Total and background concentrations as well as the differences are to be reported for each spiked sample.

Using instrumental analysis, all Youden Pairs (A and B samples for each spike level) should be run together. In addition, effluent and water samples should be run in the following order to avoid systematic errors:

Laboratory Number	Analytical order					
	1	2	3	4	5	6
1	E1	SW	E3	LP	E2	DW
2	LP	E3	E2	SW	DW	E1
3	E3	DW	E1	LP	SW	E2
4	E1	DW	E3	SW	E2	LP
5	SW	E3	DW	E2	E1	LP
6	E1	SW	E3	E2	DW	LP
7	LP	E2	DW	SW	E3	E1
8	LP	DW	E2	E1	E3	SW
9	E2	LP	E3	E1	SW	DW
10	E2	LP	SW	E3	SW	E1

3. QUALITY CONTROL/QUALITY ASSURANCE REQUIREMENTS

Each participating laboratory will be required to implement quality control/quality assurance protocols for this program. These protocols must include the following procedures:

1. Preparation of calibration curves for each element. Each curve will consist of a blank and at least four calibration standards.
2. Analysis of check standards at the beginning and end of each working day and at a frequency of 10% during analytical runs. If analysis of a check standard is not within ± 5% of the expected value, analysis must be terminated, the instrument must be recalibrated, and all samples run since last successful check standard must be reanalyzed.
3. Preparation and analysis of one procedural blank for every 15-20 samples.
4. Preparation and analysis of one spiked sample for every 15-20 samples.
5. Preparation and analysis of one duplicate sample for every 15-20 samples.
6. Analysis of an outside reference standard having known values. This sample will be provided by ERCO and will be analyzed during each analytical run.
7. Maintenance of accurate written records that trace all samples from collection through preparation, analysis, and final data submittal. Each contractor will be required to maintain all pertinent raw and final data until informed otherwise by ERCO or EPA.
8. Maintenance of logs documenting instrument repairs or modifications performed during the time frame of this study.

APPENDIX B

TRACE METALS LABORATORY QUALITY ASSURANCE PLAN

4. SUMMARY OF LABORATORY QA/AC PROGRAM

4.1 Quality Assurance Objectives

The ultimate objective of any laboratory Quality Assurance program is to detect and correct all errors of analytical problems as they occur and guarantee that all data are as accurate and precise as technically possible.

The Quality Assurance program implemented at ERCO is intended to meet the requirements of this program. Design of the protocols is the responsibility of Dr. John P. Maney and the system is implemented by the laboratory manager, Mr. Keith A. Hausknecht. A systematic use of laboratory check standards, interference check standards, standard reference materials, spiked samples, duplicates, and blanks will ensure early detection and identification of any analytical problems that may result. Documentation of quality control data will assist in the detection of any longer-term shifts in the quality of the analyses being performed.

To preclude any transcription of other errors from being included in a final data report, all data are checked by the laboratory manager, Mr. Keith A. Hausknecht, and the divisional Quality Assurance officer, Dr. John P. Maney, prior to delivery to the client.

4.2 Quality Control Procedures

The following pages are a summary of ERCO's standard quality control procedures as excerpted from the Trace Metals Laboratory Manual. Project-specific quality control requirements will be implemented if modifications of ERCO's procedures are necessary.

The laboratory will stand and fall by the quality of work performed. For this reason, a variety of quality control mechanisms have been initiated. The first type of quality control is outlined in the protocols; this includes blanks, handling procedures, etc., which should be followed by all laboratory personnel in performing the analyses. A second type of quality control is afforded by close supervision of the lab managers and lab supervisor. A third type of quality control is performed by spot checks in the laboratory. These checks are performed by the laboratory director, division manager and other chemically oriented individuals. A small percentage of errors are, from a practical point of view, impossible to eliminate. The sole purpose of Quality Control and Quality Assurance programs are to identify and correct these errors at the time that they occur.

Quality Control begins with the receipt of chemicals. All chemicals and standards are dated upon arrival. The chemicals with the oldest receiving date are used first. Standards are not used once their expiration date has passed. All standards are kept refrigerated. Standards employed for regulatory work are purchased in duplicate. Two different suppliers (Fisher, Ventron, Spex or MCB) will be used to supply the standards. Before using, these two standards are analyzed and the concentrations compared. If the standards differ in concentration, a third or fourth standard is employed to determine the correct concentration.

A service contract is maintained on all balances. A person cannot make use of a balance unless they have been checked out by laboratory personnel and their name added to the list of authorized persons posted near the balance. A set of "S" weights will be kept in the Trace Metal Laboratory for the purpose of checking accuracy.

The atomic absorption instrumentation, the water purification system, and clean benches are maintained according to specifications of the manufacturers and appropriate logs are maintained.

All samples for trace metals analysis are acidified or checked for acid preservation upon arrival.

To maintain quality control of results the following methods are employed for all priority pollutant work performed by atomic absorption spectroscopy (AAS).

4.2.1 Minimum Daily Requirements for AAS

- Calibration curves are composed of a minimum of a blank and three standards. A calibration curve is made for every hour of continuous sample analysis.

- A check standard is run approximately every 15 samples. (For priority pollutant work this standard is at the Maximum Contamination Level.)

- One duplicate sample is run every 15 samples. A duplicate sample is a sample brought through the whole sample preparation process.

- A minimum of one spike sample is run every 15 samples. The spiked concentration should be at least 10 times the detection limit concentration.

- Standard deviation is documented for all measurements being made.

- Reported concentrations cannot be less than the lowest standard analyzed.

- Samples are diluted if they are more concentrated than the highest standard or if they fall on the plateau of a calibration curve.

- All preparations employ a minimum of one blank per sample batch.

- If a significant dilution factor would be necessary to analyze a sample by the graphite furnace, the flame atomizer is used.

- Each sample batch requires a minimum of one precision determination and accuracy determination. Accuracy is determined by percent recovery of a spike.

- When available appropriate Standard Reference Materials are analyzed to evalute new procedures.

- The presence of matrix effects are determined by recoveries of standard spikes to the samples. If recovery is within 10 percent of the expected value, no interference is assumed. This test is performed for every new sample type.

4.2.2 Quarterly Requirements for AAS

- A known reference sample is analyzed once per quarter for the metals measured.

4.2.3 Annual Requirements for AAS

- Unknown performance samples (when available) are analyzed at least once a year.

4.2.4 General Requirements for AAS

- All Quality Control Data are maintained and available for easy reference or inspection using a quality control reference form (Figure 1).

- ERCO's Trace Metals Laboratory routinely participates in the performance of evaluation tests required by U.S. EPA and other federal or state agencies.

- The calibration blank is analyzed once every 10 samples. The results should be within two standard deviations of the mean.

- An inter-element interference check sample is analyzed at the initiation, end, and at periodic intervals throughout the sample run.

- One of every 10 samples will be prepared and analyzed in duplicate.

QUALITY CONTROL REPORT FORM

Date_____ ELEMENT_____

Analyst_____

ERCO ID#_____

- SRM_____or CHECK STD._____

  Certified or Prepared conc._____

  Average Reported Conc._____

  % Difference_____

- DUPLICATES

  Concentration A_____ $\frac{A-B}{(A+B/2)}$ x 100 = _____%

  Concentration B_____

- RECOVERY

$$\frac{\text{C spiked (____) - C unspiked (____)}}{\text{C True Spiked (_____)}} \times 100 = \text{_____}\%$$

Method of Standard Additions Employed? yes_____ no_____

Highest Std run_____ Flame_____ Flameless_____

Lowest Std run_____ N_2O/C_2H_2_____

Detection Limit_____ Air/C_2H_2_____

Blank levels_____ BKG. Corr. yes_____ no_____

COMMENTS:

Figure 1. Quality Control Report Form

- A minimum of one sample per every 20 samples is spiked with multi-element standard and analyzed. If recoveries are not in the 90-110% range, the samples are analyzed by the method of standard additions.

- A procedural blank is required once for every 15 samples or every sample batch, whichever is smaller.

- A new sample matrix is evaluated by analyzing serial dilutions and spike additions. The serial dilutions must agree to within 5% and the standard addition recovery must be within 10%.

- Spectral interferences are evaluated using a wavelength scan of the spectral region of interest or comparative testing by atomic absorption spectroscopy should be performed.

4.3 Data Reporting Management System

All data generated during this program will be reported to Versar Inc. using coding forms provided by the prime contractor. Analytical and quality control data will be entered on forms by staff by the Trace Metals Laboratory. Data will be verified prior to transcription by Mr. Keith A. Hausknecht and Dr. John P. Maney to ensure accuracy and adherence to contract requirements. Following transcription, data will be verified for accuracy by Mr. Hausknecht and Dr. Maney before delivery to Versar Inc. All project documentation will be maintained on-file at ERCO and will be provided to Versar Inc. on request.

4.4 Corrective Action Procedures

Samples will be prepared and analyzed in batches. Each batch will have the appropriate number of duplicates, blanks, spiked samples, and standard reference materials. The analytical results for these quality control samples will be indicative of the caliber of the batch analysis and will be helpful in locating any problems that may occur.

Reagent and procedural blanks will be used to detect contamination from reagents, ambient dust fallout, or unclean glassware. Standard reference materials will be useful in evaluating the efficiency of sample preparation while check standards and spiked and duplicate samples will document the accuracy and precision of the analysis and the analytical program in its entirety.

This system of quality control samples is used to determine if problems are preparation-, standard-, or instrument-related. After identifying the source of the problem, corrective measures are then a matter of routine.

Implementation of quality control in the laboratory is the responsibility of Mr. Hausknecht. He monitors the progress and quality of work on a daily basis and is notified by staff members if results do not meet project requirements. Analytical procedures are then examined in consultation with Dr. Maney to determine the source of the problem, and corrective action is taken. These actions may include, but are not limited to, preparing new standards or reagents, recalibrating the analytical instruments, repairing the analytical instruments, preparing new samples, reanalyzing sample digestates, and analyzing samples by standard additions. Quality assurance is monitored by Dr. Maney on a weekly

basis. If quality assurance protocols do not meet project specifications, the laboratory manager is notified and procedures are reevaluated to ensure adherence to contract requirements.

APPENDIX C

RESULTS OF INTERLABORATORY METHOD VALIDATION STUDY

Laboratory Pure, Drinking, and Surface Water:

- Raw data for analysis by water type.
- Statistical summary for analysis by water type.
- Effect of water type on analysis.

Effluent 1:

- Raw data for analysis by water type.
- Statistical summary for analysis by water type.
- Effect of water type on analysis.

Effluent 2:

- Raw data for analysis by water type.
- Statistical summary for analysis by water type.
- Effect of water type on analysis.

Effluent 3:

- Raw data for analysis by water type.
- Statistical summary for analysis by water type.
- Effect of water type on analysis.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ALUMINUM ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	1	2	1	2	1	2
TRUE CONC:	28.00	33.50	28.00	33.50	28.00	33.50
LAB NUMBER						
1	101.90	54.00	77.00	173.00	5.00	126.00
2	43.00	51.00	83.00	126.00	74.00	82.00
3	72.40	70.60	42.00	30.00	< 10.00*	40.00
4	43.00	49.00	43.00	42.00	- 260.00*	- 290.00*
5	12.00*	12.00*	31.00*	32.00*	22.00	14.00
6	27.00	17.00	47.00	57.00	120.00	59.00
7	- 19.00*	- 23.00*	90.00	88.00	250.00	400.00
8	32.40	1.50	60.00	36.00	26.00	20.00
9	4940.00*	3530.00*	79.00	125.00	- 14.00*	- 5.00*
10	100.00	50.00	0.00*	0.00*	300.00	450.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ALUMINUM ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	3	4	3	4	3	4
TRUE CONC:	74.10	64.50	74.10	64.50	74.10	64.50
LAB NUMBER						
1	219.30	113.80	118.00	94.00	- 112.50*	- 74.00*
2	43.00	39.00	181.00	52.00	221.00	210.00*
3	114.00	105.00	92.00	65.00	100.00	10.00
4	95.00	65.00	140.00	87.00	- 310.00*	- 250.00*
5	6.00*	4.00*	19.00*	16.00*	31.00	38.00
6	37.00	34.00	69.00	88.00	49.00	< 0.20*
7	- 1.00*	- 34.00*	155.00	195.00	310.00	950.00*
8	131.00	48.10	115.00	64.80	89.00	69.00
9	3060.00*	2590.00*	105.00	204.00	10.00	16.00
10	100.00	100.00	50.00*	50.00*	200.00	0.00*

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ALUMINUM ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	5	6	5	6	5	6
TRUE CONC:	125.00	111.00	125.00	111.00	125.00	111.00
LAB NUMBER						
1	138.20	107.50	220.00	109.00	53.00	- 15.00*
2	42.00	51.00	171.00	94.00	163.00	108.00
3	185.00	142.00	145.00	132.00	< 10.00*	< 10.00*
4	140.00	120.00	130.00	140.00	- 190.00*	- 210.00*
5	9.00*	9.00*	16.00*	24.00*	62.00	90.00
6	66.00	55.00	171.00	108.00	102.00	44.00
7	8440.00*	8440.00*	245.00	155.00	- 40.00*	- 90.00*
8	53.00	127.00	214.00	211.00	151.00	126.00
9	2970.00*	2500.00*	264.00	198.00	129.00	184.00
10	150.00	150.00	100.00*	50.00*	200.00	200.00

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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR ALUMINUM ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3	
LOW YOUDEN PAIR	1	2	1	2	1	2
NUMBER OF DATA POINTS	7	7	8	8	7	8
TRUE CONC (C) UG/L	28.00	33.50	28.00	33.50	28.00	33.50
MEAN RECOVERY (X)	59.96	41.87	65.13	84.63	113.86	148.88
ACCURACY(%REL ERROR)	114.13	24.99	132.59	152.61	306.63	344.40
OVERALL STD DEV (S)	31.46	23.88	19.46	52.22	117.49	174.63
OVERALL REL STD DEV, %	52.47	57.03	29.88	61.71	103.19	117.30
SINGLE STD DEV, (SR)	17.47		27.98		61.66	
ANALYST REL DEV, %	34.31		37.38		46.94	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4
NUMBER OF DATA POINTS	7	7	8	8	8	4
TRUE CONC (C) UG/L	74.10	64.50	74.10	64.50	74.10	64.50
MEAN RECOVERY (X)	105.61	72.13	121.88	106.22	126.25	33.25
ACCURACY(%REL ERROR)	42.53	11.83	64.47	64.69	70.38	-48.45
OVERALL STD DEV (S)	61.12	33.60	35.77	59.34	106.11	26.70
OVERALL REL STD DEV, %	57.87	46.58	29.35	55.86	84.05	80.30
SINGLE STD DEV, (SR)	30.50		48.61		32.23	
ANALYST REL DEV, %	34.31		42.62		40.41	
HIGH YOUDEN PAIR	5	6	5	6	5	6
NUMBER OF DATA POINTS	7	7	8	8	7	6
TRUE CONC (C) UG/L	125.00	111.00	125.00	111.00	125.00	111.00
MEAN RECOVERY (X)	110.60	107.50	195.00	143.38	122.86	125.33
ACCURACY(%REL ERROR)	-11.52	-3.15	56.00	29.17	-1.71	12.91
OVERALL STD DEV (S)	55.87	39.75	47.99	42.60	53.87	58.62
OVERALL REL STD DEV, %	50.51	36.98	24.61	29.71	43.85	46.77
SINGLE STD DEV, (SR)	27.08		31.20		32.12	
ANALYST REL DEV, %	24.84		18.44		25.89	

WATER LEGEND

1 - LAB PURE WATER
2 - DRINKING WATER
3 - SURFACE WATER

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON ALUMINUM ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .67942

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.5299	-.0136
3	1.1780	-.2312

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	14.83706	14.83706		
REG(WATER/DISTILLED)	4	4.89298	1.22324	2.55	.0426
ERROR	115	55.07978	.47895		
TOTAL	120	74.80981			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	.5299	(-2.2077 , 3.2675)	-.0136	(-.6678 , .6406)
3	1.1780	(-1.6571 , 4.0130)	-.2312	(-.9118 , .4495)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ALIMINUM ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - MG/L

	LAB PURE WATER		EFFLUENT 1	
AMPUL NO:	1	2	1	2
TRUE CONC:	12.60	11.00	12.60	11.00
LAB NUMBER				
1	24.88*	11.51	18.74	11.32
2	10.92	10.32	14.80	12.20
3	12.28*	14.38*	5.00	2.70
4	11.55	10.50	5.00	11.00
5	0.06*	0.10*	39.30*	29.00*
6	13.65	12.07	5.60*	6.40*
7	9.18	10.44	32.00*	35.20*
8	14.28	12.07	11.40	9.90
9	10.02	10.27	7.30	6.10
10	16.80	12.60	15.00	15.00

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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ALIMINIM ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - MG/L

	LAB PURE WATER		EFFLUENT 1	
AMPUL NO:	3	4	3	4
TRUE CONC:	21.70	25.70	21.70	25.70
LAB NUMBER				
1	25.71	31.47	37.74	47.26
2	21.10	26.46	27.80	33.50
3	33.81*	28.56*	9.20	16.30
4	23.10	26.25	16.00	14.00
5	0.05*	0.01*	27.20	78.50*
6	28.77	34.75	10.60*	8.20*
7	7.81	6.87*	33.90*	35.20*
8	23.63	26.46	19.70	25.90
9	0.45	28.01	12.50	23.40
10	21.00	21.00	15.00	25.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ALUMINUM ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - MG/L

	LAB PURE WATER		EFFLUENT 1	
AMPUL NO:	5	6	5	6
TRUE CONC:	58.30	49.60	58.30	49.60
LAB NUMBER				
1	65.52	26.35	81.96	70.56
2	52.39	54.39	48.40	43.30
3	65.20*	69.82*	48.50	67.90
4	54.60	46.20	52.00	65.00
5	0.35*	0.49*	90.80	48.70
6	50.40	51.45	12.80*	8.50*
7	26.14	31.39	75.70*	83.10*
8	60.69	50.19	57.70	44.10
9	46.18	5.65	61.50	58.30
10	63.00	52.50	45.00	45.00

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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR ALUMINUM ANALYSES BY WATER TYPE

	WATER 1		WATER 2	
LOW YOUDEN PAIR	1	2	1	2
NUMBER OF DATA POINTS	7	8	7	7
TRUE CONC (C) MG/L	12.60	11.00	12.60	11.00
MEAN RECOVERY (X)	12.34	11.22	11.03	9.75
ACCURACY(%REL ERROR)	-2.05	2.03	-12.43	-11.40
OVERALL STD DEV (S)	2.69	0.95	5.42	4.10
OVERALL REL STD DEV, %	21.79	8.45	49.11	42.02
SINGLE STD DEV, (SR)	1.25		2.82	
ANALYST REL DEV, %	10.59		27.11	
MEDIUM YOUDEN PAIR	3	4	3	4
NUMBER OF DATA POINTS	8	7	8	7
TRUE CONC (C) MG/L	21.70	25.70	21.70	25.70
MEAN RECOVERY (X)	18.95	27.77	20.64	26.48
ACCURACY(%REL ERROR)	-12.68	8.06	-4.87	3.04
OVERALL STD DEV (S)	9.68	4.36	9.55	11.20
OVERALL REL STD DEV, %	51.11	15.70	46.25	42.29
SINGLE STD DEV, (SR)	6.51		3.08	
ANALYST REL DEV, %	27.88		13.06	
HIGH YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	8	8	8	8
TRUE CONC (C) MG/L	58.30	49.60	58.30	49.60
MEAN RECOVERY (X)	52.37	39.77	60.73	55.36
ACCURACY(%REL ERROR)	-10.18	-19.83	4.17	11.61
OVERALL STD DEV (S)	12.48	17.22	16.86	11.43
OVERALL REL STD DEV, %	23.83	43.31	27.76	20.64
SINGLE STD DEV, (SR)	12.62		13.20	
ANALYST REL DEV, %	27.40		22.73	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 1

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON ALUMINUM ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .85731

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	-.8729	.3145

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	35.83426	35.83426		
REG(WATER/DISTILLED)	2	1.20953	.60476	2.36	.1010
ERROR	78	19.97960	.25615		
TOTAL	81	57.02339			

** TARLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	-.8729	(-2.1295 , .3837)	.3145	(-.0673 , .6964)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ALUMINUM ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - MG/L

	LAB PURE WATER		EFFLUENT 2	
AMPUL NO:	1	2	1	2
TRUE CONC:	0.46	0.51	0.46	0.51
LAB NUMBER				
1	0.92*	0.53	0.25	0.26
2	0.41	0.47	0.31	0.30
3	0.46*	0.66*	1.23*	0.58*
4	0.43	0.48	0.43	0.48
5	0.00*	0.00*	0.03*	0.03*
6	0.51	0.55	0.72	0.69
7	0.34	0.48	0.39	0.83
8	0.53	0.55	0.43	0.83
9	0.37	0.47	0.82	0.75
10	0.62	0.58	0.50	0.50

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ALUMINUM ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - MG/L

	LAB PURE WATER		EFFLUENT 2	
AMPUL NO:	3	4	3	4
TRUE CONC:	1.01	1.11	1.01	1.11
LAB NUMBER				
1	1.20	1.35	0.74	0.80
2	0.98	1.13	0.90	1.10
3	1.58*	1.22*	4.53*	1.69*
4	1.08	1.13	1.00	1.10
5	0.00*	0.00*	0.02*	0.02*
6	1.34	1.49	1.14	1.31
7	0.36	0.29*	3.94*	0.51
8	1.10	1.13	0.65	1.08
9	0.02	1.20	1.48	1.49
10	0.98	0.90	1.10	1.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ALUMINUM ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - MG/L

	LAB PURE WATER		EFFLUENT 2	
AMPUL NO:	5	6	5	6
TRUE CONC:	2.18	1.76	2.18	1.76
LAB NUMBER				
1	2.43	0.93	1.73	1.25
2	1.95	1.92	1.90	1.54
3	2.42*	2.46*	2.92*	2.43*
4	2.03	1.63	2.20	1.80
5	0.01*	0.02*	0.02*	0.02*
6	1.87	1.81	2.09	1.88
7	0.97	1.11	4.24*	1.20
8	2.25	1.77	2.19	1.55
9	1.71	0.20	0.94*	1.10
10	2.34	1.85	2.20	1.80

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR ALUMINUM ANALYSES BY WATER TYPE

	WATER 1		WATER 2	
LOW YOUDEN PAIR	1	2	1	2
NUMBER OF DATA POINTS	7	8	8	8
TRUE CONC (C) MG/L	0.46	0.51	0.46	0.51
MEAN RECOVERY (X)	0.46	0.51	0.48	0.58
ACCURACY(%REL ERROR)	-0.77	1.38	4.06	14.65
OVERALL STD DEV (S)	0.10	0.04	0.20	0.23
OVERALL REL STD DEV, %	21.77	8.46	40.67	39.13
SINGLE STD DEV, (SR)	0.04		0.14	
ANALYST REL DEV, %	8.45		26.80	
MEDIUM YOUDEN PAIR	3	4	3	4
NUMBER OF DATA POINTS	8	7	7	8
TRUE CONC (C) MG/L	1.01	1.11	1.01	1.11
MEAN RECOVERY (X)	0.88	1.19	1.00	1.05
ACCURACY(%REL ERROR)	-12.44	7.25	-0.75	-5.51
OVERALL STD DEV (S)	0.45	0.19	0.28	0.30
OVERALL REL STD DEV, %	51.10	15.72	27.46	28.38
SINGLE STD DEV, (SR)	0.30		0.12	
ANALYST REL DEV, %	29.07		11.57	
HIGH YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	8	8	6	8
TRUE CONC (C) MG/L	2.18	1.76	2.18	1.76
MEAN RECOVERY (X)	1.94	1.40	2.05	1.51
ACCURACY(%REL ERROR)	-10.78	-20.38	-5.89	-13.94
OVERALL STD DEV (S)	0.46	0.61	0.20	0.30
OVERALL REL STD DEV, %	23.84	43.31	9.53	19.99
SINGLE STD DEV, (SR)	0.45		0.10	
ANALYST REL DEV, %	27.00		5.62	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 2

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON ALUMINUM ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .84089

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.1062	.0320

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	21.75032	21.75032		
REG(WATER/DISTILLED)	2	.26147	.13073	.49	.6144
ERROR	80	21.34386	.26680		
TOTAL	83	43.35565			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERCEPT(WATER-DISTILLED) INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	SLOPE(WATER-DISTILLED) INTERVAL
2	.1062	(-.1370 , .3495)	.0320	(-.3908 , .4547)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TEST CATEGORY ***

RAW DATA FOR ALUMINIM ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 3	
AMPUL NO:	1	2	1	2
TRUE CONC:	26.80	32.00	26.80	32.00
LAB NUMBER				
1	97.80	51.80	85.00	139.00
2	41.00	49.00	39.00	47.00
3	70.00	68.00	114.00	114.00
4	41.00	47.00	68.00	64.00
5	11.50*	11.50*	40.00	72.00
6	26.00	16.00	< 0.20*	< 0.20*
7	- 19.00*	- 23.00*	-1720.00*	-1730.00*
8	31.10	1.40	67.00	39.00
9	4742.00*	3389.00*	4.70	47.80
10	96.00	48.00	50.00	50.00

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*** EPA METHOD STUDY - TEST CATEGORY ***

RAW DATA FOR ALUMINUM ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 3	
AMPUL NO:	3	4	3	4
TRUE CONC:	70.90	61.70	70.90	61.70
LAB NUMBER				
1	210.50	109.30	85.00	127.00
2	41.30	37.40	59.00	44.00
3	109.00	101.00	176.00	130.00
4	91.00	62.00	100.00	83.00
5	5.80*	3.80*	58.00	19.00
6	36.00	33.00	4.00	< 0.20*
7	- 1.00*	- 34.00*	-1440.00*	-1610.00*
8	126.00	46.00	150.00	90.00
9	2938.00*	2486.00*	134.00	112.00
10	96.00	96.00	100.00	100.00

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*** EPA METHOD STUDY - TEST CATEGORY ***

RAW DATA FOR ALUMINUM ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 3	
AMPUL NO:	5	6	5	6
TRUE CONC:	120.00	107.00	120.00	107.00
LAB NUMRER				
1	132.70	103.20	161.00	99.00
2	40.30	49.00	61.00*	63.00
3	178.00	136.00	147.00	191.00
4	134.00	115.00	130.00	120.00
5	8.60*	8.60*	342.00*	X8500.00*
6	63.00	53.00	172.00	230.00
7	8102.00*	8102.00*	700.00*	3100.00*
8	51.00	122.00	160.00	290.00
9	2851.00*	2400.00*	148.00	197.00
10	144.00	144.00	150.00	150.00

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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TEST CATEGORY ***

STATISTICAL SUMMARY FOR ALUMINUM ANALYSES BY WATER TYPE

	WATER 1		WATER 2	
LOW YOUDEN PAIR	1	2	1	2
NUMBER OF DATA POINTS	7	7	8	8
TRUE CONC (C) UG/L	26.80	32.00	26.80	32.00
MEAN RECOVERY (X)	57.56	40.17	58.46	71.60
ACCURACY(%REL ERROR)	114.77	25.54	118.14	123.75
OVERALL STD DEV (S)	30.27	23.03	33.02	36.05
OVERALL REL STD DEV, %	52.58	57.34	56.49	50.36
SINGLE STD DEV, (SR)	16.81		19.42	
ANALYST REL DEV, %	34.40		29.87	
MEDIUM YOUDEN PAIR	3	4	3	4
NUMBER OF DATA POINTS	7	7	9	8
TRUE CONC (C) UG/L	70.90	61.70	70.90	61.70
MEAN RECOVERY (X)	101.40	69.24	96.22	88.13
ACCURACY(%REL ERROR)	43.02	12.23	35.72	42.83
OVERALL STD DEV (S)	58.58	32.27	52.67	39.15
OVERALL REL STD DEV, %	57.77	46.61	54.73	44.43
SINGLE STD DEV, (SR)	29.34		22.23	
ANALYST REL DEV, %	34.39		24.12	
HIGH YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	7	7	7	8
TRUE CONC (C) UG/L	120.00	107.00	120.00	107.00
MEAN RECOVERY (X)	106.14	103.17	152.57	167.50
ACCURACY(%REL ERROR)	-11.55	-3.58	27.14	56.54
OVERALL STD DEV (S)	53.72	38.06	13.36	74.17
OVERALL REL STD DEV, %	50.61	36.89	8.76	44.28
SINGLE STD DEV, (SR)	26.06		43.11	
ANALYST REL DEV, %	24.90		26.94	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 3

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*** EPA METHOD STUDY - TEST CATEGORY ***

EFFECT OF WATER TYPE ON ALUMINUM ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .67955

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.0709	.0545

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	13.86420	13.86420		
REG(WATER/DISTILLED)	2	1.73841	.86921	1.99	.1433
ERROR	78	34.04081	.43642		
TOTAL	81	49.64342			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERCEPT(WATER-DISTILLED) INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	SLOPE(WATER-DISTILLED) INTERVAL
2	.0709	(-2.2883 , 2.4302)	.0545	(-.5132 , .6223)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ANTIMONY ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	1	2	1	2	1	2
TRUE CONC:	11.00	12.70	11.00	12.70	11.00	12.70
LAB NUMBER						
1	10.00	11.50	8.20	9.50	11.40	11.50
2	9.00	13.00	10.00	10.00	8.00	11.00
3	5.30	7.40	20.10*	20.10*	10.80	< 4.80*
4	< 5.00*	< 5.00*	< 5.00*	5.70*	7.70	< 5.00*
5	28.00*	30.00*	38.00*	45.00*	31.00*	37.00*
6	5.00	6.00	8.00	9.00	9.00	8.00
7	3.00	4.00	4.00*	4.00*	< 2.00*	< 2.00*
8	< 5.00*	< 5.00*	< 5.00*	< 5.00*	11.00	9.00
9	3.70	2.50	6.50	2.90	7.10	7.70
10	9.00	6.00	9.00	6.00	6.00	3.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ANTIMONY ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	3	4	3	4	3	4
TRUE CONC:	56.80	47.30	56.80	47.30	56.80	47.30
LAB NUMBER						
1	43.60	35.90	54.10	46.70	51.10	39.60
2	74.00	107.00*	41.00	37.00	53.00	47.00
3	26.80	41.30	77.00*	62.50*	33.20	19.50
4	24.00*	22.00*	26.00*	17.00*	35.00	21.00
5	156.00*	90.00*	168.00*	131.00*	117.00*	70.00*
6	27.00	22.00	49.00	40.00	49.00	41.00
7	30.00	32.00	30.00*	20.00*	18.00*	11.00*
8	42.00	37.00	51.00	43.00	54.00	31.00
9	43.40	38.90	40.00	51.00	28.60	36.40
10	50.00	30.00	40.00	40.00	40.00	30.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ANTIMONY ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	5	6	5	6	5	6
TRUE CONC:	240.00	200.00	240.00	200.00	240.00	200.00
LAB NUMBER						
1	231.00	210.00	231.00	209.00	240.00	208.00
2	205.00	191.00	192.00	174.00	192.00	172.00
3	349.00	195.00	317.00*	316.00*	108.00	72.90*
4	150.00*	140.00*	130.00*	97.00*	120.00	190.00
5	897.00*	520.00*	721.00*	742.00*	616.00*	535.00*
6	85.00	78.00	195.00	164.00	205.00	173.00
7	152.00	86.00	91.00*	74.00*	87.00*	70.00*
8	230.00	190.00	180.00	159.00	240.00	196.00
9	194.00	39.60	217.00	47.40	181.00	163.00
10	200.00	210.00	200.00	260.00	250.00	190.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR ANTIMONY ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3	
LOW YOUDEN PAIR	1	2	1	2	1	2
NUMBER OF DATA POINTS	7	7	5	5	8	6
TRUE CONC (C) UG/L	11.00	12.70	11.00	12.70	11.00	12.70
MEAN RECOVERY (X)	6.43	7.20	8.34	7.48	8.87	8.37
ACCURACY(%REL ERROR)	-41.56	-43.31	-24.18	-41.10	-19.32	-34.12
OVERALL STD DEV (S)	2.84	3.82	1.30	3.00	2.01	3.05
OVERALL REL STD DEV, %	44.22	53.00	15.53	40.06	22.61	36.46
SINGLE STD DEV, (SR)	1.61		1.62		1.50	
ANALYST REL DEV, %	23.56		20.46		17.40	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4
NUMBER OF DATA POINTS	8	7	6	6	8	8
TRUE CONC (C) UG/L	56.80	47.30	56.80	47.30	56.80	47.30
MEAN RECOVERY (X)	42.10	33.87	45.85	42.95	42.99	33.19
ACCURACY(%REL ERROR)	-25.88	-28.39	-19.28	-9.20	-24.32	-29.84
OVERALL STD DEV (S)	15.55	6.50	6.27	5.13	9.99	9.67
OVERALL REL STD DEV, %	36.93	19.20	13.67	11.95	23.25	29.13
SINGLE STD DEV, (SR)	7.36		5.35		6.20	
ANALYST REL DEV, %	19.37		12.05		16.27	
HIGH YOUDEN PAIR	5	6	5	6	5	6
NUMBER OF DATA POINTS	8	8	6	6	8	7
TRUE CONC (C) UG/L	240.00	200.00	240.00	200.00	240.00	200.00
MEAN RECOVERY (X)	205.75	149.95	202.50	168.90	192.00	184.57
ACCURACY(%REL ERROR)	-14.27	-25.02	-15.63	-15.55	-20.00	-7.71
OVERALL STD DEV (S)	75.01	69.67	18.45	70.45	54.12	15.79
OVERALL REL STD DEV, %	36.46	46.46	9.11	41.71	28.19	8.55
SINGLE STD DEV, (SR)	45.82		52.73		29.67	
ANALYST REL DEV, %	25.76		28.39		15.76	

WATER LEGEND

1 - LAB PURE WATER
2 - DRINKING WATER
3 - SURFACE WATER

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON ANTIMONY ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = 1.10775

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.2737	-.0439
3	.2993	-.0482

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	198.89603	198.89603		
REG(WATER/DISTILLED)	4	.34976	.08744	.81	.5182
ERROR	110	11.80203	.10729		
TOTAL	115	211.04781			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	.2737	(-.3897 , .9371)	-.0439	(-.2014 , .1136)
3	.2993	(-.3107 , .9092)	-.0482	(-.1942 , .0978)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ANTIMONY ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	1	2	1	2	1	2	1	2
TRUE CONC:	10.50	12.20	10.50	12.20	10.50	12.20	10.50	12.20
LAB NUMBER								
1	7.20	8.70	9.10	11.10	5.00	6.50	4.20	5.80
2	9.80	< 8.70	< 6.00*	6.00	6.00	7.00	< 6.00*	6.00
3	17.40	12.20	17.50	19.70	25.60	34.10	13.40	48.00*
4	< 5.00*	< 5.00*	9.70	6.80	10.00	7.60	< 5.00*	6.50
5	42.00*	51.00*	4.00*	28.00*	31.00*	39.00*	29.00*	44.00*
6	4.00	4.60	2.00	3.00	25.00	47.00	< 0.50*	4.00
7	2.30	3.30	3.00*	4.00*	4.00*	5.00*	3.00	4.00
8	< 5.00*	< 5.00*	< 5.00*	< 5.00*	< 5.00*	< 5.00*	< 5.00*	< 5.00*
9	6.40	6.60	6.70	8.40	4.50	4.30	2.50*	1.20*
10	13.00	6.50	6.00	6.00	9.00	12.00	12.00	9.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ANTIMONY ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	3	4	3	4	3	4	3	4
TRUE CONC:	54.30	45.20	54.30	45.20	54.30	45.20	54.30	45.20
LAB NUMBER								
1	52.10	40.50	68.40	48.10	36.00	29.00	25.50	23.70
2	44.50	39.10	52.00	35.00	34.00	30.00	28.00	23.00
3	10.30	11.00	33.70	50.40	44.30	32.60	4.80	31.80
4	22.80	15.20	30.00	41.00	48.00	27.00	33.00	24.00
5	157.00*	115.00*	73.00*	71.00*	231.00*	213.00*	74.00*	114.00*
6	21.00	22.00	37.00	39.00	31.00	32.00	20.00	18.00
7	29.00	16.00	17.00*	19.00*	29.00*	24.00*	24.00	28.00
8	18.00	14.00	63.00	23.00	61.00	48.00*	31.00	42.00
9	35.30	23.10	24.00	36.00	36.60	35.00	15.30*	15.40*
10	52.00	42.00	80.00	40.00	70.00	30.00	51.00	39.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ANTIMONY ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	5	6	5	6	5	6	5	6
TRUE CONC:	230.00	191.00	230.00	191.00	230.00	191.00	230.00	191.00
LAB NUMBER								
1	267.00	222.00	304.00*	237.00	156.00	151.00	127.00	104.00
2	201.00	174.00	178.00	158.00	187.00	164.00	183.00	160.00
3	204.00	153.00	214.00	134.00	200.00	143.00	101.00	135.00
4	119.00	94.00	180.00	150.00	150.00	130.00	150.00	120.00
5	720.00*	671.00*	251.00*	301.00*	818.00*	957.00*	380.00*	210.00*
6	78.00	78.00	176.00	136.00	121.00	122.00	112.00	98.00
7	119.00	86.00	80.00*	77.00*	124.00*	87.00*	94.00	85.00
8	195.00	160.00	200.00	160.00	200.00	181.00	173.00	187.00
9	108.00	179.00	190.00	196.00	252.00	158.00	14.60*	13.90*
10	195.00	141.00	200.00	200.00	230.00	200.00	160.00	210.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR ANTIMONY ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	7	7	6	7	7	7	4	6
TRUE CONC (C) UG/L	10.50	12.20	10.50	12.20	10.50	12.20	10.50	12.20
MEAN RECOVERY (X)	8.59	7.23	8.50	8.71	12.16	16.93	8.15	5.88
ACCURACY(%REL ERROR)	-18.23	-40.75	-19.05	-28.57	15.78	38.76	-22.38	-51.78
OVERALL STD DEV (S)	5.26	2.95	5.19	5.44	9.20	16.72	5.31	1.86
OVERALL REL STD DEV, %	61.24	40.85	61.03	62.42	75.69	98.77	65.12	31.53
SINGLE STD DEV, (SR)	2.26		1.36		5.88		1.77	
ANALYST REL DEV, %	28.57		15.79		40.43		25.20	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	9	9	8	8	8	7	8	8
TRUE CONC (C) UG/L	54.30	45.20	54.30	45.20	54.30	45.20	54.30	45.20
MEAN RECOVERY (X)	31.67	24.77	48.51	39.06	45.11	30.80	27.16	28.69
ACCURACY(%REL ERROR)	-41.68	-45.21	-10.66	-13.58	-16.92	-31.86	-49.98	-36.53
OVERALL STD DEV (S)	15.21	12.42	20.37	8.44	13.93	2.62	12.99	8.34
OVERALL REL STD DEV, %	48.04	50.15	41.99	21.61	30.89	8.52	47.84	29.08
SINGLE STD DEV, (SR)	3.78		16.33		10.13		8.88	
ANALYST REL DEV, %	13.39		37.30		26.69		31.81	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	9	9	7	8	8	8	8	8
TRUE CONC (C) UG/L	230.00	191.00	230.00	191.00	230.00	191.00	230.00	191.00
MEAN RECOVERY (X)	165.11	143.00	191.14	171.38	187.00	156.13	137.50	137.38
ACCURACY(%REL ERROR)	-28.21	-25.13	-16.89	-10.27	-18.70	-18.26	-40.22	-28.08
OVERALL STD DEV (S)	61.31	48.43	14.18	36.15	43.26	25.79	33.76	44.66
OVERALL REL STD DEV, %	37.13	33.87	7.42	21.09	23.13	16.52	24.55	32.51
SINGLE STD DEV, (SR)	27.22		20.30		21.84		20.85	
ANALYST REL DEV, %	17.67		11.25		12.73		15.17	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 1
3 - EFFLUENT 2
4 - EFFLUENT 3

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON ANTIMONY ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = 1.04577

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.0392	.0476
3	.6648	-.0979
4	-.1230	.0118

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	249.89424	249.89424		
REG(WATER/DISTILLED)	6	4.23787	.70631	3.81	.0014
ERROR	165	30.61802	.18556		
TOTAL	172	284.75014			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	.0392	(-.8042 , .8827)	.0476	(-.1552 , .2504)
3	.6648	(-.1623 , 1.4919)	-.0979	(-.2965 , .1006)
4	-.1230	(-1.0051 , .7590)	.0118	(-.1968 , .2204)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ARSENIC ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	1	2	1	2	1	2
TRUE CONC:	12.40	10.20	12.40	10.20	12.40	10.20
LAB NUMBER						
1	8.60	4.80	18.00*	12.60*	13.20*	12.50*
2	12.00	10.00	13.00	8.00	11.00	12.00
3	13.20	9.10	14.40	11.80	11.20	11.20
4	13.00	17.00	11.00	12.00	12.00	11.00
5	10.00	8.00	5.00*	4.00*	5.00	4.00
6	22.00*	19.00	8.80	8.80	5.90	8.40
7	8.00*	8.00*	15.00	5.00	3.00	1.00
8	10.50	8.50	11.70	< 3.00*	15.00	9.90
9	< 3.00*	4.60*	11.00	8.60	9.00	0.00*
10	10.00	10.00	15.00	15.00	10.00	10.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ARSENIC ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	3	4	3	4	3	4
TRUE CONC:	51.80	61.80	51.80	61.80	51.80	61.80
LAB NUMBER						
1	48.50	86.60*	67.70*	76.60*	88.20*	102.60*
2	44.00	52.00	44.00	49.00	42.00	51.00
3	44.60	58.40	47.90	56.50	35.50	67.70
4	47.00	57.00	48.00	60.00	58.00	75.00
5	42.00	47.00	36.00*	55.00*	38.00	51.00
6	47.00	58.00	42.00	53.00	47.00	55.00
7	15.00*	22.00*	22.00*	15.00*	58.00	64.00
8	48.80	60.20	55.00	66.00	54.00	48.00
9	40.50*	51.80*	41.20	49.50	33.50	44.50
10	50.00	60.00	45.00	65.00	60.00	60.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ARSENIC ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	5	6	5	6	5	6
TRUE CONC:	237.00	211.00	237.00	211.00	237.00	211.00
LAB NUMBER						
1	324.90	240.50	259.00*	232.00*	383.00*	317.00*
2	220.00	211.00	226.00	206.00	230.00	207.00
3	248.00	212.00	235.00	207.00	250.00	207.00
4	200.00	180.00	210.00	210.00	210.00	180.00
5	218.00	191.00	34.00*	39.00*	198.00	188.00
6	218.00	187.00	282.00	253.00	87.00*	126.00
7	80.00*	79.00*	148.00	146.00	163.00	173.00
8	221.00	172.00	236.00	192.00	208.00	165.00
9	163.00*	149.00*	224.00	212.00	227.00	184.00
10	135.00	225.00	255.00	165.00	220.00	195.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR ARSENIC ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3	
LOW YOUDEN PAIR	1	2	1	2	1	2
NUMBER OF DATA POINTS	7	8	8	7	9	8
TRUE CONC (C) UG/L	12.40	10.20	12.40	10.20	12.40	10.20
MEAN RECOVERY (X)	11.04	10.80	12.49	9.89	9.12	8.44
ACCURACY(%REL ERROR)	-10.94	5.88	0.71	-3.08	-26.43	-17.28
OVERALL STD DEV (S)	1.72	4.77	2.24	3.28	3.81	3.90
OVERALL REL STD DEV, %	15.61	44.13	17.95	33.18	41.80	46.22
SINGLE STD DEV, (SR)	1.94		2.69		1.59	
ANALYST REL DEV, %	17.78		24.06		18.10	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4
NUMBER OF DATA POINTS	8	7	7	7	9	9
TRUE CONC (C) UG/L	51.80	61.80	51.80	61.80	51.80	61.80
MEAN RECOVERY (X)	46.49	56.09	46.16	57.00	47.33	57.36
ACCURACY(%REL ERROR)	-10.26	-9.25	-10.89	-7.77	-8.62	-7.19
OVERALL STD DEV (S)	2.73	4.85	4.70	6.96	10.49	10.05
OVERALL REL STD DEV, %	5.87	8.65	10.18	12.21	22.15	17.53
SINGLE STD DEV, (SR)	1.96		3.30		7.62	
ANALYST REL DEV, %	3.83		6.40		14.56	
HIGH YOUDEN PAIR	5	6	5	6	5	6
NUMBER OF DATA POINTS	8	8	8	8	8	9
TRUE CONC (C) UG/L	237.00	211.00	237.00	211.00	237.00	211.00
MEAN RECOVERY (X)	223.11	202.31	227.00	198.88	213.25	180.56
ACCURACY(%REL ERROR)	-5.86	-4.12	-4.22	-5.75	-10.02	-14.43
OVERALL STD DEV (S)	52.57	23.67	38.72	32.37	25.81	24.88
OVERALL REL STD DEV, %	23.56	11.70	17.06	16.27	12.10	13.78
SINGLE STD DEV, (SR)	35.49		20.50		13.21	
ANALYST REL DEV, %	16.68		9.63		6.71	

WATER LEGEND

1 - LAB PURE WATER
2 - DRINKING WATER
3 - SURFACE WATER

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON ARSENIC ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = 1.00050

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.0688	-.0092
3	-.4418	.0922

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	228.15218	228.15218		
REG(WATER/DISTILLED)	4	.75614	.18903	2.53	.0435
ERROR	128	9.55621	.07466		
TOTAL	133	238.46452			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	.0688	(-.4198 , .5573)	-.0092	(-.1251 , .1068)
3	-.4418	(-.9154 , .0318)	.0922	(-.0213 , .2057)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ARSENIC ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	1	2	1	2	1	2	1	2
TRUE CONC:	11.80	9.78	11.80	9.78	11.80	9.78	11.80	9.78
LAB NUMBER								
1	13.50	18.30	21.60	10.60	5.00	1.10	5.80	7.00
2	16.30	13.20	8.00* <	8.00* <	8.00* <	8.00* <	8.00* <	8.00*
3	32.90*	28.30*	33.60	4.00	13.10	8.40 <	1.00* <	1.00*
4	17.40	12.00	39.00	16.00	17.00	14.00	11.00	11.00
5	16.30	18.50	27.00	27.00	6.00	1.00	10.00	10.00
6	19.60	16.30	20.00	17.00 <	0.20* <	0.20*	5.00	2.00
7	8.70*	6.50*	16.00*	11.00*	3.00*	3.00*	12.00	10.00
8	7.90	8.50	17.00	18.00	12.00	11.00	15.00	13.00
9	4.80	15.20	30.30	24.30	10.80	9.00 -	7.30* -	10.30*
10	16.30	10.90	25.00	20.00	10.00	15.00	5.00 <	5.00*

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ARSENIC ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	3	4	3	4	3	4	3	4
TRUE CONC:	49.60	59.10	49.60	59.10	49.60	59.10	49.60	59.10
LAB NUMBER								
1	70.40	93.10	74.10	100.10	41.20	53.90	45.60	52.00
2	47.86	59.80	28.00*	49.00*	20.00*	31.00*	27.00	32.00
3	79.50*	121.00*	75.30	97.30	29.20	45.00	24.60	41.50
4	47.90	68.50	59.00	76.00	28.00	65.00	45.00	56.00
5	65.30	52.20	65.00	75.00	45.00	41.00	45.00	55.00
6	57.70	76.10	57.00	71.00	54.00	51.00	42.00	57.00
7	13.10*	18.50*	50.00*	68.00*	13.00*	11.00*	47.00	58.00
8	46.20	66.80	65.00	80.00	51.00	69.00	53.00	69.00
9	35.90	49.20	73.80	79.80	44.10	51.30	22.90*	31.60*
10	60.00	70.70	70.00	90.00	55.00	60.00	30.00	50.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ARSENIC ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	5	6	5	6	5	6	5	6
TRUE CONC:	227.00	202.00	227.00	202.00	227.00	202.00	227.00	202.00
LAB NUMBER								
1	312.70	271.90	256.00	287.00	196.00	293.00	191.00	212.00
2	217.80	199.00	138.00*	112.00*	155.00*	130.00*	192.00	173.00
3	359.00*	266.00*	207.00	258.00	238.00	188.00	219.00	185.00
4	207.00	207.00	220.00	180.00	210.00	200.00	220.00	190.00
5	211.00	193.60	200.00	171.00	225.00	212.00	236.00	197.00
6	243.00	226.00	287.00	250.00	221.00	259.00	240.00	205.00
7	163.00*	130.50*	130.00*	140.00*	79.00*	68.00*	147.00	127.00
8	173.00	198.00	182.00	172.00	176.00	210.00	188.00	186.00
9	190.00	170.00	378.00	275.00	165.00	143.00	187.00*	46.20*
10	272.00	207.00	285.00	180.00	165.00	180.00	170.00	155.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR ARSENIC ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	8	8	8	8	7	7	7	6
TRUE CONC (C) UG/L	11.80	9.78	11.80	9.78	11.80	9.78	11.80	9.78
MEAN RECOVERY (X)	14.01	14.11	26.69	17.11	10.56	8.50	9.11	8.83
ACCURACY(%REL ERROR)	18.75	44.30	126.17	74.97	-10.53	-13.09	-22.76	-9.68
OVERALL STD DEV (S)	5.08	3.58	7.37	7.31	4.12	5.63	3.92	3.87
OVERALL REL STD DEV, %	36.28	25.39	27.60	42.72	39.07	66.21	43.00	43.80
SINGLE STD DEV, (SR)	3.92		7.85		2.43		1.13	
ANALYST REL DEV, %	27.88		35.87		25.51		12.62	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	8	8	8	8	8	8	9	9
TRUE CONC (C) UG/L	49.60	59.10	49.60	59.10	49.60	59.10	49.60	59.10
MEAN RECOVERY (X)	53.91	67.05	67.40	83.65	43.44	54.52	39.91	52.28
ACCURACY(%REL ERROR)	8.68	13.45	35.89	41.54	-12.42	-7.74	-19.53	-11.54
OVERALL STD DEV (S)	11.40	13.98	7.02	10.82	10.36	9.61	10.06	10.54
OVERALL REL STD DEV, %	21.15	20.85	10.42	12.93	23.85	17.62	25.20	20.16
SINGLE STD DEV, (SR)	8.13		4.58		9.34		3.52	
ANALYST REL DEV, %	13.45		6.06		19.08		7.63	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	8	8	8	8	8	8	9	9
TRUE CONC (C) UG/L	227.00	202.00	227.00	202.00	227.00	202.00	227.00	202.00
MEAN RECOVERY (X)	228.31	209.06	251.88	221.63	199.50	210.63	200.33	181.11
ACCURACY(%REL ERROR)	0.58	3.50	10.96	9.72	-12.11	4.27	-11.75	-10.34
OVERALL STD DEV (S)	45.73	29.84	64.21	50.34	28.41	46.70	30.93	26.39
OVERALL REL STD DEV, %	20.03	14.27	25.49	22.72	14.24	22.17	15.44	14.57
SINGLE STD DEV, (SR)	18.70		39.45		32.18		13.48	
ANALYST REL DEV, %	8.55		16.66		15.69		7.07	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 1
3 - EFFLUENT 2
4 - EFFLUENT 3

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON ARSENIC ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .92941

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.6338	-.1034
3	-.9734	.1753
4	-.8470	.1350

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	261.60674	261.60674		
REG(WATER/DISTILLED)	6	12.17275	2.02879	14.78	.0000
ERROR	174	23.87803	.13723		
TOTAL	181	297.65753			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	.6338	(-.0357 , 1.3033)	-.1034	(-.2663 , .0595)
3	-.9734	(-1.6620 , -.2848)	.1753	(.0092 , .3414)
4	-.8470	(-1.5452 , -.1488)	.1350	(-.0314 , .3013)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR BARIUM ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	1	2	1	2	1	2
TRUE CONC:	62.70	59.10	62.70	59.10	62.70	59.10
LAB NUMBER						
1	25.00*	23.00*	1.00*	34.00*	312.00*	264.00*
2	114.00	120.00	68.00	45.00	77.00	73.00
3	112.00*	91.70*	111.00	101.00	86.30	80.30
4	64.00	83.00	100.00	110.00	80.00	90.00
5	91.00	80.00	104.00*	217.00*	< 12.00*	< 7.00*
6	91.00	83.00	117.00	114.00	128.00	115.00
7	68.00	56.00	99.00	73.00	79.00	70.00
8	45.00	28.00	110.00	297.00*	67.20	50.20
9	106.00	104.00	597.00*	75.30	138.20	104.20
10	90.00	90.00	90.00	105.00	70.00	100.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR BARIUM ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	3	4	3	4	3	4
TRUE CONC:	165.00	194.00	165.00	194.00	165.00	194.00
LAB NUMBER						
1	142.00*	139.00*	14.00*	20.00*	302.00	176.00
2	212.00	250.00	120.00	118.00	180.00	198.00
3	259.00*	243.00*	241.00	294.00	10.10	194.00
4	170.00	180.00	210.00	220.00	220.00	250.00
5	246.00	176.00	256.00*	332.00*	129.00*	47.00*
6	185.00	217.00	246.00	297.00	220.00	208.00
7	132.00	175.00	169.00	183.00	165.00	189.00
8	98.00	87.00	90.00	150.00	98.20	181.20
9	193.00	252.00	82.10	104.10	227.20	238.20
10	100.00	230.00	220.00	160.00	90.00	160.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR BARIUM ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	5	6	5	6	5	6
TRUE CONC:	379.00	437.00	379.00	437.00	379.00	437.00
LAB NUMBER						
1	22.00*	32.00*	84.00*	126.00*	529.00	582.00
2	282.00	346.00	244.00	322.00	286.00	328.00
3	596.00*	460.00*	456.00	555.00	515.00	413.00
4	320.00	370.00	470.00	530.00	430.00	510.00
5	485.00	583.00*	469.00*	853.00*	249.00*	68.00*
6	362.00	407.00	333.00	397.00	501.00	617.00
7	363.00	403.00	409.00	469.00	374.00	463.00
8	427.00	787.00*	720.00	660.00	183.20	271.20
9	334.00	370.00	300.00	293.00	437.20	475.20
10	300.00	450.00	410.00	560.00	470.00	420.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR BARIUM ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3	
LOW YOUDEN PAIR	1	2	1	2	1	2
NUMBER OF DATA POINTS	8	8	7	7	8	8
TRUE CONC (C) UG/L	62.70	59.10	62.70	59.10	62.70	59.10
MEAN RECOVERY (X)	83.63	80.50	99.29	89.04	90.71	85.34
ACCURACY(%REL ERROR)	33.37	36.21	58.35	50.66	44.68	44.40
OVERALL STD DEV (S)	22.97	28.21	16.49	25.32	26.96	21.11
OVERALL REL STD DEV, %	27.47	35.05	16.61	28.43	29.72	24.74
SINGLE STD DEV, (SR)	8.20		11.88		13.41	
ANALYST REL DEV, %	9.99		12.61		15.23	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4
NUMBER OF DATA POINTS	8	8	8	8	9	9
TRUE CONC (C) UG/L	165.00	194.00	165.00	194.00	165.00	194.00
MEAN RECOVERY (X)	167.00	195.88	172.26	190.76	168.06	199.38
ACCURACY(%REL ERROR)	1.21	0.97	4.40	-1.67	1.85	2.77
OVERALL STD DEV (S)	53.12	54.28	67.09	73.94	88.68	28.96
OVERALL REL STD DEV, %	31.81	27.71	38.94	38.76	52.77	14.53
SINGLE STD DEV, (SR)	40.66		27.59		58.48	
ANALYST REL DEV, %	22.41		15.20		31.83	
HIGH YOUDEN PAIR	5	6	5	6	5	6
NUMBER OF DATA POINTS	8	6	8	8	9	9
TRUE CONC (C) UG/L	379.00	437.00	379.00	437.00	379.00	437.00
MEAN RECOVERY (X)	359.13	391.00	417.75	473.25	413.93	453.27
ACCURACY(%REL ERROR)	-5.24	-10.53	10.22	8.30	9.22	3.72
OVERALL STD DEV (S)	67.70	36.85	144.88	127.34	115.21	111.10
OVERALL REL STD DEV, %	18.85	9.42	34.68	26.91	27.83	24.51
SINGLE STD DEV, (SR)	30.52		45.27		50.32	
ANALYST REL DEV, %	8.14		10.16		11.61	

WATER LEGEND

1 - LAB PURE WATER
2 - DRINKING WATER
3 - SURFACE WATER

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON BARIUM ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .81406

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.1221	-.0002
3	.0404	.0021

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	56.28216	56.28216		
REG(WATER/DISTILLED)	4	.31291	.07823	.53	.7108
ERROR	129	18.89010	.14643		
TOTAL	134	75.48517			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERCEPT(WATER-DISTILLED) INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	SLOPE(WATER-DISTILLED) INTERVAL
2	.1221	(-1.2246 , 1.4689)	-.0002	(-.2604 , .2600)
3	.0404	(-1.2669 , 1.3478)	.0021	(-.2516 , .2558)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR BARIUM ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	1	2	1	2	1	2	1	2
TRUE CONC:	60.00	56.50	60.00	56.50	60.00	56.50	60.00	56.50
LAB NUMBER								
1	152.00	123.00	-2960.00*	-4100.00*	52.00*	45.00*	- 10.00*	- 4.00*
2	172.00	177.00	114.00	98.00	87.00	75.00	68.00	25.00
3	150.00	130.00	168.00	91.00	77.10	69.00	130.00	84.20
4	106.00	89.00	80.00	100.00	120.00	100.00	120.00	93.00
5	212.00*	145.00*	165.00	263.00	*	263.00*	215.00*	250.00*
6	145.00	145.00	220.00	244.00	130.00	95.00	255.00*	277.00*
7	93.00	103.00	62.00	51.00	104.00	118.00	102.00	90.00
8	136.00	85.00	116.00	109.00	23.00	10.00*	130.00	84.00
9	117.00*	72.70*	53.00	461.00*	81.80	74.80	92.10	73.00
10	161.00	161.00	65.00	75.00	130.00	95.00	45.00	15.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR BARIUM ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	3	4	3	4	3	4	3	4
TRUE CONC:	157.00	185.00	157.00	185.00	157.00	185.00	157.00	185.00
LAB NUMBER								
1	148.00	203.00	-3400.00*	-3660.00*	65.00*	84.00*	- 66.00*	- 46.00*
2	283.00	335.00	158.00	190.00	121.00	119.00	52.00	92.00
3	320.00	311.00	304.00	377.00	234.00	249.00	50.20	34.20
4	215.00	215.00	210.00	240.00	250.00	310.00	240.00*	230.00
5	368.00*	312.00*	207.00	368.00	491.00*	179.00	353.00*	360.00*
6	27.00	25.00	233.00	220.00	192.00	254.00	234.00*	241.00*
7	156.00	189.00	94.00	103.00	179.00	191.00	110.00	121.00
8	400.00	221.00	348.00	320.00	81.00	89.00	51.00	4.00
9	35.40*	48.50*	282.00	377.00	58.70	208.00	61.70	143.00
10	236.00	258.00	255.00	215.00	245.00	175.00	125.00	105.00

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OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR BARIUM ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	5	6	5	6	5	6	5	6
TRUE CONC:	362.00	418.00	362.00	418.00	362.00	418.00	362.00	418.00
LAB NUMBER								
1	220.00	231.00	-1590.00*	-2370.00*	97.00*	124.00*	- 95.00*	- 97.00*
2	369.00	399.00	190.00	304.00	127.00	135.00	92.00	100.00*
3	512.00	590.00	564.00	632.00	460.00	451.00	98.20	162.00
4	333.00	376.00	490.00	570.00	300.00	440.00	210.00	150.00
5	849.00*	805.00*	505.00	367.00	237.00	553.00	359.00*	284.00*
6	521.00	465.00	540.00	702.00	810.00	687.00	673.00*	741.00*
7	394.00	419.00	418.00	469.00	459.00	532.00	340.00	411.00*
8	394.00	437.00	420.00	287.00	206.00	330.00	399.00	177.00
9	314.00*	360.00*	320.00	114.00	100.00	190.00	95.60	179.00
10	483.00	537.00	425.00	225.00	375.00	375.00	205.00	165.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR BARIUM ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	8	8	9	8	8	7	7	7
TRUE CONC (C) UG/L	60.00	56.50	60.00	56.50	60.00	56.50	60.00	56.50
MEAN RECOVERY (X)	139.38	126.63	115.89	128.88	94.11	89.54	98.16	66.31
ACCURACY(%REL ERROR)	132.29	124.12	93.15	128.10	56.85	58.48	63.60	17.37
OVERALL STD DEV (S)	27.02	33.35	57.78	79.13	35.64	17.46	32.38	32.38
OVERALL REL STD DEV, %	19.39	26.34	49.86	61.40	37.87	19.50	32.99	48.83
SINGLE STD DEV, (SR)	14.53		34.67		12.20		9.59	
ANALYST REL DEV, %	10.92		28.33		13.29		11.66	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	8	8	9	9	8	9	6	7
TRUE CONC (C) UG/L	157.00	185.00	157.00	185.00	157.00	185.00	157.00	185.00
MEAN RECOVERY (X)	223.13	219.63	232.33	267.78	170.09	197.11	74.98	104.17
ACCURACY(%REL ERROR)	42.12	18.72	47.98	44.74	8.34	6.55	-52.24	-43.69
OVERALL STD DEV (S)	115.33	94.30	76.89	97.26	75.02	68.41	33.53	73.83
OVERALL REL STD DEV, %	51.69	42.94	33.10	36.32	44.11	34.70	44.72	70.87
SINGLE STD DEV, (SR)	53.00		45.78		44.89		32.85	
ANALYST REL DEV, %	23.94		18.31		24.45		36.67	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	8	8	9	9	9	9	7	5
TRUE CONC (C) UG/L	362.00	418.00	362.00	418.00	362.00	418.00	362.00	418.00
MEAN RECOVERY (X)	403.25	431.75	430.22	407.78	341.56	410.33	205.69	166.60
ACCURACY(%REL ERROR)	11.40	3.29	18.85	-2.45	-5.65	-1.83	-43.18	-60.14
OVERALL STD DEV (S)	101.36	108.16	116.86	198.00	219.03	175.46	123.85	11.84
OVERALL REL STD DEV, %	25.13	25.05	27.16	48.56	64.13	42.76	60.21	7.11
SINGLE STD DEV, (SR)	28.01		102.32		86.95		86.17	
ANALYST REL DEV, %	6.71		24.42		23.13		46.29	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 1
3 - EFFLUENT 2
4 - EFFLUENT 3

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON BARIUM ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .58320

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	-.5028	.0940
3	-.7873	.1060
4	.0685	-.1704

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	42.63186	42.63186		
REG(WATER/DISTILLED)	6	16.66139	2.77690	9.09	.0000
ERROR	173	52.87321	.30563		
TOTAL	180	112.16647			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	-.5028	(-2.4217 , 1.4161)	.0940	(-.2801 , .4681)
3	-.7873	(-2.7512 , 1.1765)	.1060	(-.2757 , .4877)
4	.0685	(-1.9911 , 2.1280)	-.1704	(-.5749 , .2340)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR BERYLLIUM ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	1	2	1	2	1	2
TRUE CONC:	0.63	0.47	0.63	0.47	0.63	0.47
LAB NUMBER						
1	0.60	0.07	0.69	0.24	0.83	0.50
2	0.40 <	0.50*	0.60 <	0.50*	0.50 <	0.50*
3	< 0.60* <	0.60* <	0.60* <	0.60*	0.80 <	0.60*
4	< 0.50* <	0.50*	0.50 <	0.50* <	0.50* <	0.50*
5	1.00*	1.00	1.00 <	0.50* <	0.50* <	0.50*
6	< 0.30* <	0.30*	0.80*	0.40*	1.00*	0.90*
7	0.50	0.30	0.70	0.50	0.80	0.50
8	< 0.50* <	0.50* <	0.50* <	0.50* <	0.50* <	0.50*
9	0.56	0.44	0.55	0.33	0.68	0.57
10	0.60	0.40	0.40	0.40	0.60	0.40

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR BERYLLIUM ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	3	4	3	4	3	4
TRUE CONC:	1.59	1.91	1.59	1.91	1.59	1.91
LAB NUMBER						
1	1.37	1.64	1.76	2.11	1.66	2.56
2	1.60	1.90	1.40	1.80	1.60	1.80
3	1.50	2.20	1.10	1.80	1.50	1.90
4	1.20	1.20	1.10	1.40	1.20	1.50
5	1.00	4.00*	2.00	2.00	1.00	2.00
6	1.70	1.90	1.70*	3.20*	2.10*	2.40*
7	1.10	1.50	1.70	2.00	1.80	2.30
8	< 0.50*	< 0.50*	< 0.50*	0.50*	10.00*	5.00*
9	1.10	1.60	1.83	2.07	1.77	2.14
10	1.40	1.80	1.40	1.80	1.40	1.60

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR BERYLLIUM ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	5	6	5	6	5	6
TRUE CONC:	9.09	11.40	9.09	11.40	9.09	11.40
LAB NUMBER						
1	8.89	11.42	11.31	12.54	12.30	11.80
2	10.10	13.20	17.00*	10.80	8.80	11.80
3	10.50	13.20	8.90	10.60	8.90	10.70
4	6.50	8.40	7.60	9.60	7.10	9.30
5	10.00	14.00	8.00	10.00	4.00	7.00
6	17.00*	17.00	17.00*	19.00*	11.00*	12.00*
7	7.70	16.00	9.20	11.00	11.00	12.50
8	6.50*	11.00*	7.40*	10.10*	6.90	9.10
9	7.00	11.30	10.70	14.40	0.57	1.19*
10	9.00	11.00	8.00	10.00	9.00	11.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR BERYLLIUM ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3	
LOW YOUDEN PAIR	1	2	1	2	1	2
NUMBER OF DATA POINTS	5	5	7	4	6	4
TRUE CONC (C) UG/L	0.63	0.47	0.63	0.47	0.63	0.47
MEAN RECOVERY (X)	0.53	0.44	0.63	0.37	0.70	0.49
ACCURACY(%REL ERROR)	-15.82	-5.56	0.36	-21.47	11.02	5.24
OVERALL STD DEV (S)	0.08	0.34	0.19	0.11	0.13	0.07
OVERALL REL STD DEV, %	15.86	77.69	30.35	29.92	18.83	14.20
SINGLE ANALYST STD DEV, (SR)	0.13		0.13		0.07	
SINGLE ANALYST REL DEV, %	26.47		25.99		11.86	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4
NUMBER OF DATA POINTS	9	8	8	8	8	8
TRUE CONC (C) UG/L	1.59	1.91	1.59	1.91	1.59	1.91
MEAN RECOVERY (X)	1.33	1.72	1.54	1.87	1.49	1.97
ACCURACY(%REL ERROR)	-16.35	-10.08	-3.38	-1.96	-6.21	3.40
OVERALL STD DEV (S)	0.24	0.30	0.34	0.23	0.28	0.35
OVERALL REL STD DEV, %	18.36	17.62	21.95	12.23	18.76	17.93
SINGLE ANALYST STD DEV, (SR)	0.15		0.14		0.22	
SINGLE ANALYST REL DEV, %	9.67		8.08		12.48	
HIGH YOUDEN PAIR	5	6	5	6	5	6
NUMBER OF DATA POINTS	8	9	7	8	9	8
TRUE CONC (C) UG/L	9.09	11.40	9.09	11.40	9.09	11.40
MEAN RECOVERY (X)	8.71	12.84	9.10	11.12	7.62	10.40
ACCURACY(%REL ERROR)	-4.17	12.59	0.13	-2.48	-16.18	-8.77
OVERALL STD DEV (S)	1.50	2.65	1.42	1.60	3.57	1.82
OVERALL REL STD DEV, %	17.22	20.68	15.64	14.42	46.83	17.52
SINGLE ANALYST STD DEV, (SR)	1.47		0.55		0.78	
SINGLE ANALYST REL DEV, %	13.68		5.41		8.67	

WATER LEGEND

1 - LAB PURE WATER
2 - DRINKING WATER
3 - SURFACE WATER

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON BERYLLIUM ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = 1.10692

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.1543	-.0738
3	.2403	-.2182

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	167.76915	167.76915		
REG(WATER/DISTILLED)	4	1.52294	.38073	3.02	.0207
ERROR	114	14.37090	.12606		
TOTAL	119	183.66299			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERCEPT(WATER-DISTILLED) INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	SLOPE(WATER-DISTILLED) INTERVAL
2	.1543	(-.0934 , .4019)	-.0738	(-.2385 , .0909)
3	.2403	(-.0108 , .4914)	-.2182	(-.3850 , -.0513)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR BERYLLIUM ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	1	2	1	2	1	2	1	2
TRUE CONC:	0.60	0.45	0.60	0.45	0.60	0.45	0.60	0.45
LAB NUMBER								
1	0.21	0.17	0.07 -	0.30* -	0.18* -	0.67*	0.09 -	0.01*
2	0.43	0.11	0.50 <	0.50*	0.50 <	0.50* <	0.50* <	0.50*
3	< 0.60* <	0.60*	1.20	0.70	0.70 <	0.60* <	0.60* <	0.60*
4	< 0.50* <	0.50* <	0.50*	0.50 <	0.50* <	0.50* <	0.50* <	0.50*
5	2.72*	1.50*	1.00	1.00	4.00*	1.00	1.00 <	0.50*
6	< 0.30* <	0.30*	1.30*	1.00*	1.50*	1.20*	1.50*	1.00*
7	0.33	0.22	0.40	0.20	0.70	0.50	0.40	0.30
8	< 0.50* <	0.50* <	0.50* <	0.50* <	0.50* <	0.50* <	0.50* <	0.50*
9	0.53	0.47	0.56	0.48	0.40	0.24	0.52	0.47
10	0.43	0.43	0.60	0.40	0.60	0.40	0.60	0.40

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR BERYLLIUM ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	3	4	3	4	3	4	3	4
TRUE CONC:	1.52	1.83	1.52	1.83	1.52	1.83	1.52	1.83
LAB NUMBER								
1	1.79	2.75	1.40	2.29	1.60	1.61	1.27	1.84
2	1.74	2.29	1.40	1.80	1.60	2.00	1.20	2.20
3	1.96	1.85	1.90	2.40	1.70	2.10	1.40	1.80
4	1.09	1.41	1.30	1.00	1.10*	1.40*	1.00	1.30
5	5.40*	9.20*	2.80*	3.00	2.00	3.00*	1.00	2.00
6	1.85	3.30	3.50*	5.10*	4.20*	5.20*	3.70*	4.80*
7	1.20	1.50	0.80	1.10	1.70	2.10	1.00	1.20
8	< 0.50*	< 0.50*	< 0.50*	< 0.50*	< 0.50*	< 0.50*	< 0.50*	< 0.50*
9	1.20	1.60	1.44	1.86	1.20	1.93	1.56	1.66
10	1.74	1.52	1.40	2.00	1.40	1.80	1.40	1.80

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR BERYLLIUM ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	5	6	5	6	5	6	5	6
TRUE CONC:	8.70	10.90	8.70	10.90	8.70	10.90	8.70	10.90
LAB NUMBER								
1	6.71	6.99	8.72	12.45	10.40	12.30	10.97	10.73
2	11.50	13.90	8.10	10.00	9.60	10.80	12.10	11.30
3	10.80	13.40	11.10	13.90	12.00	14.20	9.50	11.60
4	7.10	8.80	6.00	7.60	7.00*	8.30*	6.90	8.90
5	34.80*	40.20*	7.00	10.00	8.00	14.00	6.00	8.00
6	16.30	19.70	24.00*	19.00*	19.00*	24.00*	20.00*	26.00*
7	8.00	10.40	4.80	8.40	9.60	11.40	4.40	8.00
8	2.40*	7.90*	5.60*	7.70*	6.50*	8.90*	7.60	9.30
9	7.65	8.40	9.55	12.20	9.53	20.30*	9.51	12.10
10	8.70	10.90	8.00	10.00	8.00	11.00	8.00	10.00

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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR BERYLLIUM ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	5	5	7	6	5	4	5	3
TRUE CONC (C) UG/L	0.60	0.45	0.60	0.45	0.60	0.45	0.60	0.45
MEAN RECOVERY (X)	0.39	0.28	0.62	0.55	0.58	0.53	0.52	0.39
ACCURACY(%REL ERROR)	-36.09	-37.50	2.41	22.02	-3.97	19.42	-13.58	-12.95
OVERALL STD DEV (S)	0.12	0.16	0.38	0.27	0.13	0.33	0.33	0.09
OVERALL REL STD DEV, %	31.39	57.37	60.85	50.25	22.48	61.30	63.25	21.91
SINGLE STD DEV, (SR)	0.09		0.13		0.02		0.05	
ANALYST REL DEV, %	26.76		23.05		2.93		11.84	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	8	8	7	8	7	6	8	8
TRUE CONC (C) UG/L	1.52	1.83	1.52	1.83	1.52	1.83	1.52	1.83
MEAN RECOVERY (X)	1.57	2.03	1.38	1.93	1.60	1.92	1.23	1.72
ACCURACY(%REL ERROR)	3.37	10.79	-9.40	5.53	5.26	5.10	-19.16	-5.74
OVERALL STD DEV (S)	0.35	0.69	0.32	0.66	0.25	0.19	0.22	0.34
OVERALL REL STD DEV, %	22.06	34.08	23.30	34.32	15.73	9.91	17.61	19.43
SINGLE STD DEV, (SR)	0.38		0.26		0.16		0.24	
ANALYST REL DEV, %	21.39		15.52		9.16		16.33	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	8	8	8	8	7	6	9	9
TRUE CONC (C) UG/L	8.70	10.90	8.70	10.90	8.70	10.90	8.70	10.90
MEAN RECOVERY (X)	9.59	11.56	7.91	10.57	9.59	12.28	8.33	9.99
ACCURACY(%REL ERROR)	10.29	6.07	-9.09	-3.04	10.23	12.69	-4.24	-8.33
OVERALL STD DEV (S)	3.20	4.06	1.99	2.13	1.39	1.50	2.44	1.54
OVERALL REL STD DEV, %	33.36	35.12	25.16	20.16	14.45	12.21	29.25	15.38
SINGLE STD DEV, (SR)	0.72		0.55		1.22		0.96	
ANALYST REL DEV, %	6.82		6.00		11.17		10.51	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 1
3 - EFFLUENT 2
4 - EFFLUENT 3

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON BERYLLIUM ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = 1.13352

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.1623	-.1312
3	.2424	-.0980
4	.0399	-.0771

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	238.56398	238.56398		
REG(WATER/DISTILLED)	6	1.25327	.20888	1.86	.0919
ERROR	146	16.41387	.11242		
TOTAL	153	256.23112			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	.1623	(-.0792 , .4037)	-.1312	(-.2937 , .0314)
3	.2424	(-.0163 , .5011)	-.0980	(-.2728 , .0768)
4	.0399	(-.2186 , .2984)	-.0771	(-.2483 , .0941)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR CADMIUM ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	1	2	1	2	1	2
TRUE CONC:	0.45	0.79	0.45	0.79	0.45	0.79
LAB NUMBER						
1	0.63	0.85	0.61	1.15	0.30	0.56
2	< 0.20*	< 0.20*	0.80	0.80	0.80	1.30
3	< 0.50*	< 0.50*	3.05*	2.30*	< 0.50*	4.20
4	0.50	1.00	1.10	1.80	0.60	0.80
5	1.00*	2.00*	2.00*	1.00	1.00*	1.00*
6	0.50	0.70	0.70	0.40	0.20	0.30
7	0.50	0.80	0.40	0.70	0.40	0.70
8	< 0.50*	< 0.50*	< 0.50*	< 0.50*	< 0.50*	< 0.50*
9	0.36	0.81	0.46	0.57	2.29*	3.54
10	0.60	1.20	0.60	1.10	0.40	0.80

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR CADMIUM ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	3	4	3	4	3	4
TRUE CONC:	4.55	5.32	4.55	5.32	4.55	5.32
LAB NUMBER						
1	5.66	5.64	4.61	5.06	3.93	4.41
2	4.60	4.30	5.20	10.10*	5.40	7.00
3	2.85	4.70	6.40*	6.25*	2.15	3.25
4	5.10	5.50	5.50	5.50	4.80	5.50
5	4.00	5.00	7.00	6.00	9.00*	8.50*
6	4.40	5.40	3.90	4.90	4.50	4.40
7	3.50	4.50	3.50	3.90	3.80	4.40
8	3.60	4.40	2.60*	3.80*	2.00*	1.00*
9	3.27	2.90	4.04	3.97	3.21	4.20
10	5.00	6.00	5.00	7.00	4.90	5.90

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR CADMIUM ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	5	6	5	6	5	6
TRUE CONC:	12.50	10.10	12.50	10.10	12.50	10.10
LAB NUMBER						
1	13.90	11.60	2.97	9.15	14.05	12.55
2	20.60	16.30	53.90*	12.70	16.90	15.90
3	7.60	7.50	25.10*	10.40*	10.20	22.10
4	11.00	10.00	12.00	9.70	12.00	10.00
5	12.00	9.00	16.00	12.00	25.00*	19.00*
6	10.90	9.20	11.00	9.30	10.40	8.90
7	15.00	9.90	7.90	6.70	7.90	7.10
8	13.90	11.50	10.80*	6.00*	10.20*	6.70*
9	5.54	4.99	10.20	7.28	12.60	7.82
10	14.00	12.00	14.00	12.00	9.90	9.90

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR CADMIUM ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3	
LOW YOUDEN PAIR	1	2	1	2	1	2
NUMBER OF DATA POINTS	6	6	7	8	6	8
TRUE CONC (C) UG/L	0.45	0.79	0.45	0.79	0.45	0.79
MEAN RECOVERY (X)	0.51	0.89	0.67	0.94	0.45	1.52
ACCURACY(%REL ERROR)	13.19	12.94	46.62	18.84	-1.10	92.79
OVERALL STD DEV (S)	0.10	0.18	0.23	0.43	0.22	1.48
OVERALL REL STD DEV, %	18.45	20.05	35.05	46.17	48.18	97.36
SINGLE STD DEV, (SR)	0.11		0.25		0.10	
ANALYST REL DEV, %	16.32		30.79		10.19	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4
NUMBER OF DATA POINTS	10	10	8	7	8	8
TRUE CONC (C) UG/L	4.55	5.32	4.55	5.32	4.55	5.32
MEAN RECOVERY (X)	4.20	4.83	4.84	5.19	4.09	4.88
ACCURACY(%REL ERROR)	-7.74	-9.14	6.46	-2.44	-10.19	-8.22
OVERALL STD DEV (S)	0.90	0.89	1.11	1.10	1.05	1.18
OVERALL REL STD DEV, %	21.54	18.43	22.92	21.23	25.65	24.13
SINGLE STD DEV, (SR)	0.49		0.66		0.36	
ANALYST REL DEV, %	10.95		13.20		7.93	
HIGH YOUDEN PAIR	5	6	5	6	5	6
NUMBER OF DATA POINTS	10	10	7	8	8	8
TRUE CONC (C) UG/L	12.50	10.10	12.50	10.10	12.50	10.10
MEAN RECOVERY (X)	12.44	10.20	10.58	9.85	11.74	11.78
ACCURACY(%REL ERROR)	-0.45	0.98	-15.35	-2.44	-6.05	16.67
OVERALL STD DEV (S)	4.16	3.00	4.25	2.23	2.80	5.02
OVERALL REL STD DEV, %	33.40	29.43	40.19	22.60	23.88	42.63
SINGLE STD DEV, (SR)	1.11		2.37		3.53	
ANALYST REL DEV, %	9.84		23.18		30.02	

WATER LEGEND

1 - LAB PURE WATER
2 - DRINKING WATER
3 - SURFACE WATER

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON CADMIUM ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .91837

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.0751	-.0390
3	-.0453	.0444

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	165.66889	165.66889		
REG(WATER/DISTILLED)	4	.25561	.06390	.53	.7125
ERROR	128	15.37604	.12013		
TOTAL	133	181.30054			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERCEPT(WATER-DISTILLED) INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	SLOPE(WATER-DISTILLED) INTERVAL
2	.0751	(-.1894 , .3396)	-.0390	(-.1905 , .1125)
3	-.0453	(-.3150 , .2244)	.0444	(-.1079 , .1967)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR CADMIUM ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	1	2	1	2	1	2	1	2
TRUE CONC:	0.43	0.76	0.43	0.76	0.43	0.76	0.43	0.76
LAB NUMBER								
1	0.80	1.12	1.04*	1.66*	0.60	0.70	0.44	0.94
2	0.44 <	0.20* <	0.20* <	0.20*	0.30*	0.40*	0.20	0.60
3	5.22*	2.94* <	0.50*	7.90*	17.70*	1.10 <	0.50* <	0.50*
4	0.44	0.87 -	0.60* -	0.60*	0.40	0.90	0.50	0.80
5	1.10	2.20 N	0.00* N	0.00* N	0.00*	1.00	1.00	1.00
6	0.76	0.44	0.90	2.20	0.40	0.20	1.10	1.00
7	0.54	0.76	0.80	0.30	0.50	0.60	0.40	0.60
8 <	0.50* <	0.50* <	0.50*	1.10	0.80	2.30*	10.00* <	0.50*
9	0.29*	0.75*	0.34	0.66	0.60	0.71	0.19	0.39
10	0.54	1.10	0.80	0.80	0.30	0.60	0.50	0.80

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR CADMIUM ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	3	4	3	4	3	4	3	4
TRUE CONC:	4.35	5.09	4.35	5.09	4.35	5.09	4.35	5.09
LAB NUMBER								
1	4.89	5.87	4.98*	5.54*	4.00	4.50	6.04	6.68
2	2.00	4.70 <	0.20* <	0.20*	2.30*	1.80*	3.70	1.10
3	8.37*	9.30*	2.70	4.05	2.30	2.70	4.35	4.40
4	4.20	5.20	5.20	3.00	5.00	5.40	5.00	5.50
5	5.40	5.40	2.00	2.00	4.00	4.00	4.00	6.00
6	4.60	5.00	4.30	4.40	5.10	4.90	5.90	5.00
7	3.80	4.70	3.20	4.20	3.30	4.10	3.70	4.70
8	3.30*	4.50*	1.80	2.50	3.00	2.80	3.20	3.00
9	2.01*	3.92*	4.97	5.60	2.63	3.08	2.94	4.30
10	4.60	5.30	3.90	6.40	6.00	4.40	5.00	6.50

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR CADMIUM ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	5	6	5	6	5	6	5	6
TRUE CONC:	12.00	9.70	12.00	9.70	12.00	9.70	12.00	9.70
LAB NUMBER								
1	10.70	9.43	14.62*	12.67*	13.90	7.80	15.55	13.30
2	18.10	13.70	8.90*	5.00*	6.10*	3.50*	5.80	4.30
3	13.90*	14.40*	14.30	9.30	23.50*	9.10	9.80	12.00
4	13.10	10.90	10.00	7.70	11.00	9.40	12.00	9.70
5	10.90	9.80	8.00	4.00	8.00	7.00	17.00	14.00
6	11.00	9.10	11.90	9.90	11.50	10.20	13.50	10.60
7	14.80	8.50	10.80	8.70	8.20	7.00	12.30	9.60
8	11.00*	7.60*	5.30	5.00	9.80	7.00	7.50	7.00
9	10.10*	7.84*	7.83	8.53	6.21	6.70	9.89	8.39
10	15.20	10.90	13.40	7.40	11.40	9.40	14.00	10.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR CADMIUM ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	7	6	4	5	7	8	8	8
TRUE CONC (C) UG/L	0.43	0.76	0.43	0.76	0.43	0.76	0.43	0.76
MEAN RECOVERY (X)	0.66	1.08	0.71	1.01	0.51	0.73	0.54	0.77
ACCURACY(%REL ERROR)	51.72	42.89	63.22	33.69	18.23	-4.06	24.43	1.22
OVERALL STD DEV (S)	0.24	0.60	0.25	0.72	0.17	0.28	0.34	0.22
OVERALL REL STD DEV, %	36.53	55.66	35.37	71.51	32.59	38.76	62.31	28.70
SINGLE STD DEV, (SR)	0.33		0.54		0.17		0.14	
ANALYST REL DEV, %	37.60		62.34		26.69		21.44	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	7	7	8	8	9	9	10	10
TRUE CONC (C) UG/L	4.35	5.09	4.35	5.09	4.35	5.09	4.35	5.09
MEAN RECOVERY (X)	4.21	5.17	3.51	4.02	3.93	3.99	4.38	4.72
ACCURACY(%REL ERROR)	-3.15	1.52	-19.34	-21.05	-9.76	-21.68	0.76	-7.31
OVERALL STD DEV (S)	1.10	0.41	1.29	1.50	1.25	0.95	1.07	1.69
OVERALL REL STD DEV, %	26.07	8.02	36.88	37.35	31.74	23.74	24.49	35.80
SINGLE STD DEV, (SR)	0.60		0.95		0.50		0.95	
ANALYST REL DEV, %	12.82		25.33		12.67		20.88	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	7	7	8	8	8	9	10	10
TRUE CONC (C) UG/L	12.00	9.70	12.00	9.70	12.00	9.70	12.00	9.70
MEAN RECOVERY (X)	13.40	10.33	10.19	7.57	10.00	8.18	11.73	9.89
ACCURACY(%REL ERROR)	11.67	6.52	-15.07	-22.00	-16.66	-15.69	-2.22	1.95
OVERALL STD DEV (S)	2.79	1.73	3.04	2.07	2.45	1.34	3.52	2.90
OVERALL REL STD DEV, %	20.82	16.74	29.86	27.37	24.51	16.41	29.96	29.28
SINGLE STD DEV, (SR)	1.38		1.61		1.36		1.22	
ANALYST REL DEV, %	11.66		18.10		14.97		11.24	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 1
3 - EFFLUENT 2
4 - EFFLUENT 3

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON CADMIUM ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .91517

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	-.0711	-.0991
3	-.2614	.0133
4	-.1847	.0648

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	220.80653	220.80653		
REG(WATER/DISTILLED)	6	2.31937	.38656	3.39	.0035
ERROR	171	19.50300	.11405		
TOTAL	178	242.62890			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	-.0711	(-.3770 , .2349)	-.0991	(-.2693 , .0710)
3	-.2614	(-.5277 , .0049)	.0133	(-.1404 , .1670)
4	-.1847	(-.4428 , .0734)	.0648	(-.0856 , .2152)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR CHROMIUM ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	1	2	1	2	1	2
TRUE CONC:	10.30	13.50	10.30	13.50	10.30	13.50
LAB NUMBER						
1	11.91	13.15	9.40	19.60	8.05	12.31
2	9.00	11.00	11.00	11.00	12.00	13.00
3	8.20	12.40	4.60	6.30	8.40	9.00
4	12.00	14.00	20.00	18.00	11.00	13.00
5	5.00	6.00*	195.00*	266.00*	9.00	9.00
6	14.00*	19.00*	32.00*	28.00	15.00*	19.00*
7	11.00	14.00	14.00	11.00	10.00	10.00
8	12.00	13.00	9.00	4.00	7.20	9.10
9	9.69	14.60	12.60	13.00	13.60	18.60
10	11.00	14.00	10.00	16.00	13.00	15.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR CHROMIUM ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	3	4	3	4	3	4
TRUE CONC:	113.00	95.90	113.00	95.90	113.00	95.90
LAB NUMBER						
1	76.55	73.35	91.40	82.60	79.00	69.40
2	89.00	76.00	92.00	80.20	130.00	95.00
3	96.60	84.50	88.20	77.80	84.70	73.10
4	120.00	110.00	120.00	110.00	120.00	110.00
5	76.00	91.00	359.00*	322.00*	48.00	7.00
6	115.00*	104.00*	172.00*	152.00	156.00*	124.00*
7	62.00	78.00	124.00	124.00	247.00*	167.00
8	110.00	95.00	108.00	101.00	98.00	51.00
9	136.00	94.80	120.00	100.00	117.00	108.00
10	124.00	94.00	104.00	84.00	104.00	94.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR CHROMIUM ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	5	6	5	6	5	6
TRUE CONC:	200.00	246.00	200.00	246.00	200.00	246.00
LAB NUMBER						
1	172.95	217.05	58.40*	73.90*	146.00	198.00
2	212.00	264.00	233.00	227.00	198.00	229.00
3	205.00	228.00	194.00	252.00	176.00	209.00
4	200.00	230.00	220.00	220.00	200.00	230.00
5	214.00	192.00	338.00*	666.00*	217.00	230.00
6	287.00*	325.00*	210.00	230.00	240.00*	272.00*
7	204.00	274.00	184.00	274.00	167.00	287.00
8	190.00	239.00	180.00	230.00	167.00	219.00
9	189.00	182.00	241.00	262.00	195.00	291.00
10	224.00	274.00	194.00	264.00	194.00	274.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR CHROMIUM ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3	
LOW YOUDEN PAIR	1	2	1	2	1	2
NUMBER OF DATA POINTS	9	8	8	9	9	9
TRUE CONC (C) UG/L	10.30	13.50	10.30	13.50	10.30	13.50
MEAN RECOVERY (X)	9.98	13.27	11.32	14.10	10.25	12.11
ACCURACY(%REL ERROR)	-3.13	-1.71	9.95	4.44	-0.49	-10.28
OVERALL STD DEV (S)	2.32	1.16	4.48	7.29	2.28	3.26
OVERALL REL STD DEV, %	23.23	8.72	39.52	51.73	22.25	26.90
SINGLE STD DEV, (SR)	0.97		3.51		1.25	
ANALYST REL DEV, %	8.39		27.61		11.16	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4
NUMBER OF DATA POINTS	9	9	8	9	8	9
TRUE CONC (C) UG/L	113.00	95.90	113.00	95.90	113.00	95.90
MEAN RECOVERY (X)	98.91	88.52	105.95	101.29	97.59	86.06
ACCURACY(%REL ERROR)	-12.47	-7.70	-6.24	5.62	-13.64	-10.27
OVERALL STD DEV (S)	25.16	11.69	14.39	24.52	26.57	44.26
OVERALL REL STD DEV, %	25.44	13.20	13.58	24.21	27.23	51.44
SINGLE STD DEV, (SR)	13.13		4.67		11.57	
ANALYST REL DEV, %	14.01		4.51		12.60	
HIGH YOUDEN PAIR	5	6	5	6	5	6
NUMBER OF DATA POINTS	9	9	8	8	9	9
TRUE CONC (C) UG/L	200.00	246.00	200.00	246.00	200.00	246.00
MEAN RECOVERY (X)	201.22	233.34	207.00	244.88	184.44	240.78
ACCURACY(%REL ERROR)	0.61	-5.15	3.50	-0.46	-7.78	-2.12
OVERALL STD DEV (S)	15.40	33.41	22.70	20.49	21.93	34.36
OVERALL REL STD DEV, %	7.65	14.32	10.96	8.37	11.89	14.27
SINGLE STD DEV, (SR)	21.10		24.30		24.98	
ANALYST REL DEV, %	9.71		10.75		11.75	

WATER LEGEND

1 - LAB PURE WATER
2 - DRINKING WATER
3 - SURFACE WATER

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON CHROMIUM ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = 1.00212

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	-.0270	.0014
3	-.0054	-.0127

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	241.26772	241.26772		
REG(WATER/DISTILLED)	4	.10228	.02557	.30	.8745
ERROR	141	11.83424	.08393		
TOTAL	146	253.20425			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERCEPT(WATER-DISTILLED) INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	SLOPE(WATER-DISTILLED) INTERVAL
2	-.0270	(-.5276 , .4735)	.0014	(-.1139 , .1166)
3	-.0054	(-.4972 , .4863)	-.0127	(-.1254 , .0999)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR CHROMIUM ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	1	2	1	2	1	2	1	2
TRUE CONC:	9.87	12.90	9.87	12.90	9.87	12.90	9.87	12.90
LAB NUMBER								
1	8.87	11.24	11.55	16.35	12.60	19.90	4.19*	7.62*
2	9.80	10.90	1.20	2.70	8.00	10.00	11.00	12.00
3	6.90	7.90	7.10	7.70	10.70	10.50	< 4.10*	< 4.10*
4	10.90	13.00	11.00	6.00	15.00	16.00	12.00	13.00
5	5.40*	6.50*	24.00	20.00	5.00*	4.00*	8.00	10.00
6	10.90*	14.00*	19.00*	35.00* N	0.00* N	0.00*	23.00*	22.00*
7	4.40	7.60	119.00*	59.00*	32.00*	19.00	7.00	7.00
8	6.50	12.00	10.00	6.00	6.00	10.00	7.00	6.00
9	14.60	9.00	11.60	13.20	14.30	16.40	12.90*	18.80*
10	10.90	17.00	10.00	10.00	5.00	9.00	9.00	12.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR CHROMIUM ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	3	4	3	4	3	4	3	4
TRUE CONC:	108.00	91.70	108.00	91.70	108.00	91.70	108.00	91.70
LAB NUMBER								
1	42.34	22.77*	86.15	72.30	97.00	85.00	25.70*	19.10*
2	92.40	82.60	96.80	85.60	101.00	70.00	89.00	78.00
3	86.10	73.50	74.40	67.40	90.20	69.80	76.10	63.20
4	100.00	87.00	98.00	110.00	100.00	83.00	110.00	94.00
5	65.00*	70.00*	4.00*	2.00*	33.00*	79.00*	135.00	114.00
6	140.00*	147.00*	147.00*	139.00*	149.00	71.00	166.00*	134.00*
7	646.00*	483.00*	109.00	109.00	192.00*	172.00*	127.00	127.00
8	103.00	77.00	97.00	89.00	115.00	90.00	52.00	50.00
9	150.00	66.10	84.00	69.70	125.00	61.10	146.00*	107.00*
10	113.00	91.00	110.00	80.00	100.00	80.00	97.00	102.00

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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR CHROMIUM ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	5	6	5	6	5	6	5	6
TRUE CONC:	192.00	236.00	192.00	236.00	192.00	236.00	192.00	236.00
LAB NUMBER								
1	120.71	175.28	106.70	131.90	170.00	199.00	134.00*	175.00*
2	166.00	140.00	181.00	206.00	253.00	224.00	187.00	246.00
3	140.00	202.00	256.00	197.00	166.00	214.00	165.00	211.00
4	185.00	228.00	200.00	230.00	200.00	210.00	210.00	250.00
5	121.00*	109.00*	11.00	17.00*	3.00*	174.00*	117.00	216.00
6	282.00*	323.00*	279.00*	296.00*	361.00*	289.00	240.00*	269.00*
7	148.00	189.00	169.00	229.00	162.00	242.00	137.00	207.00
8	175.00	235.00	174.00	228.00	178.00	215.00	140.00	194.00
9	187.10	310.00	140.00	274.00	186.00	312.00	267.00*	300.00*
10	189.00	265.00	200.00	220.00	205.00	215.00	192.00	222.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR CHROMIUM ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	8	8	8	8	7	8	6	6
TRUE CONC (C) UG/L	9.87	12.90	9.87	12.90	9.87	12.90	9.87	12.90
MEAN RECOVERY (X)	9.11	11.08	10.81	10.24	10.23	13.85	9.00	10.00
ACCURACY(%REL ERROR)	-7.71	-14.11	9.49	-20.59	3.63	7.36	-8.81	-22.48
OVERALL STD DEV (S)	3.18	3.07	6.35	5.86	3.99	4.45	2.10	2.90
OVERALL REL STD DEV, %	34.95	27.75	58.80	57.24	38.98	32.13	23.31	28.98
SINGLE STD DEV, (SR)	2.54		2.43		1.74		1.00	
ANALYST REL DEV, %	25.15		23.09		14.48		10.53	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	7	6	8	8	8	8	7	7
TRUE CONC (C) UG/L	108.00	91.70	108.00	91.70	108.00	91.70	108.00	91.70
MEAN RECOVERY (X)	98.12	79.53	94.42	85.37	109.65	76.24	98.01	89.74
ACCURACY(%REL ERROR)	-9.15	-13.27	-12.58	-6.90	1.53	-16.86	-9.25	-2.13
OVERALL STD DEV (S)	32.22	9.16	12.30	16.67	19.32	9.73	28.96	27.59
OVERALL REL STD DEV, %	32.84	11.52	13.02	19.53	17.62	12.77	29.55	30.74
SINGLE STD DEV, (SR)	19.90		8.55		17.05		6.67	
ANALYST REL DEV, %	22.40		9.52		18.35		7.11	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	8	8	9	8	8	9	7	7
TRUE CONC (C) UG/L	192.00	236.00	192.00	236.00	192.00	236.00	192.00	236.00
MEAN RECOVERY (X)	163.85	218.03	159.74	214.49	190.00	235.56	164.00	220.86
ACCURACY(%REL ERROR)	-14.66	-7.61	-16.80	-9.12	-1.04	-0.19	-14.58	-6.42
OVERALL STD DEV (S)	25.16	53.54	69.44	40.36	29.79	39.01	34.02	20.48
OVERALL REL STD DEV, %	15.35	24.56	43.47	18.82	15.68	16.56	20.74	9.27
SINGLE STD DEV, (SR)	29.30		37.85		33.53		16.03	
ANALYST REL DEV, %	15.35		20.23		15.76		8.33	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 1
3 - EFFLUENT 2
4 - EFFLUENT 3

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON CHROMIUM ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = 1.00700

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	-.0770	.0035
3	.1833	-.0194
4	-.0759	.0265

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	284.98911	284.98911		
REG(WATER/DISTILLED)	6	.73232	.12205	.86	.5277
ERROR	165	23.49018	.14236		
TOTAL	172	309.21161			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	-.0770	(-.7831 , .6290)	.0035	(-.1598 , .1668)
3	.1833	(-.5293 , .8959)	-.0194	(-.1845 , .1457)
4	-.0759	(-.8359 , .6842)	.0265	(-.1473 , .2002)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR COBALT ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	1	2	1	2	1	2
TRUE CONC:	31.50	29.70	31.50	29.70	31.50	29.70
LAB NUMBER						
1	31.36	29.73	496.00*	404.00*	35.00	32.00
2	30.00	27.00	26.00	30.00	30.00	26.00
3	33.80	27.40	32.20	31.50	27.50	25.70
4	23.00	21.00	27.00	30.00	34.00	31.00
5	46.00*	38.00*	38.00	37.00	34.00	31.00
6	29.00	31.00	29.00	32.00	32.00	38.00
7	32.00	29.00	26.00	24.00	22.00*	22.00*
8	23.00	26.00	15.00	10.00	21.00	20.00
9	21.90	28.70	25.00	25.60	28.20	27.70
10	30.00	35.00	25.00	45.00	30.00	40.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR COBALT ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	3	4	3	4	3	4
TRUE CONC:	186.00	216.00	186.00	216.00	186.00	216.00
LAB NUMBER						
1	206.33	238.13	218.00	265.00	175.00	189.00
2	162.00	186.00	216.00	198.00	198.00	198.00
3	195.00	193.00	199.00	225.00	147.00	168.00
4	160.00	180.00	180.00	220.00	170.00	200.00
5	196.00*	236.00*	205.00	236.00	180.00	228.00
6	225.00	254.00	246.00	213.00	235.00	216.00
7	176.00	196.00	128.00	151.00	124.00*	143.00*
8	140.00	150.00	165.00	250.00	170.00	204.00
9	145.00	216.00	177.00	194.00	161.00	227.00
10	90.00	100.00	400.00*	250.00	150.00	150.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR COBALT ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	5	6	5	6	5	6
TRUE CONC:	420.00	314.00	420.00	314.00	420.00	314.00
LAB NUMBER						
1	377.43	304.03	35.30*	38.30	399.00	299.00
2	400.00	312.00	392.00	277.00	343.00	315.00
3	472.00	278.00	411.00	314.00	262.00	239.00
4	360.00	260.00	390.00	310.00	440.00	330.00
5	563.00*	423.00*	468.00	348.00	472.00	283.00
6	455.00	403.00	399.00	335.00	428.00	436.00
7	368.00	302.00	352.00	256.00	340.00*	256.00*
8	364.00	244.00	340.00	190.00	376.00	294.00
9	329.00	294.00	310.00	264.00	409.00	272.00
10	200.00	125.00	300.00	50.00	400.00	145.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR COBALT ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3	
LOW YOUDEN PAIR	1	2	1	2	1	2
NUMBER OF DATA POINTS	9	9	9	9	9	9
TRUE CONC (C) UG/L	31.50	29.70	31.50	29.70	31.50	29.70
MEAN RECOVERY (X)	28.23	28.31	27.02	29.46	30.19	30.16
ACCURACY(%REL ERROR)	-10.38	-4.67	-14.22	-0.82	-4.16	1.53
OVERALL STD DEV (S)	4.43	3.81	6.19	9.57	4.35	6.22
OVERALL REL STD DEV, %	15.68	13.45	22.89	32.50	14.40	20.63
SINGLE STD DEV, (SR)	3.06		5.07		3.39	
ANALYST REL DEV, %	10.82		17.96		11.22	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4
NUMBER OF DATA POINTS	9	9	9	10	9	9
TRUE CONC (C) UG/L	186.00	216.00	186.00	216.00	186.00	216.00
MEAN RECOVERY (X)	166.59	190.35	192.67	220.20	176.22	197.78
ACCURACY(%REL ERROR)	-10.43	-11.88	3.58	1.94	-5.26	-8.44
OVERALL STD DEV (S)	40.30	46.03	34.60	33.46	26.92	25.96
OVERALL REL STD DEV, %	24.19	24.18	17.96	15.19	15.27	13.12
SINGLE STD DEV, (SR)	14.57		24.52		18.59	
ANALYST REL DEV, %	8.16		11.88		9.94	
HIGH YOUDEN PAIR	5	6	5	6	5	6
NUMBER OF DATA POINTS	9	9	9	10	9	9
TRUE CONC (C) UG/L	420.00	314.00	420.00	314.00	420.00	314.00
MEAN RECOVERY (X)	369.49	280.23	373.56	238.23	392.11	290.33
ACCURACY(%REL ERROR)	-12.03	-10.76	-11.06	-24.13	-6.64	-7.54
OVERALL STD DEV (S)	78.50	73.43	53.17	111.81	61.20	77.17
OVERALL REL STD DEV, %	21.25	26.20	14.23	46.93	15.61	26.58
SINGLE STD DEV, (SR)	32.94		42.36		59.42	
ANALYST REL DEV, %	10.14		13.85		17.41	

WATER LEGEND

1 - LAB PURE WATER
2 - DRINKING WATER
3 - SURFACE WATER

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON COBALT ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .97236

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	-.0125	-.0051
3	.0363	.0002

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	171.82590	171.82590		
REG(WATER/DISTILLED)	4	.15006	.03752	.47	.7600
ERROR	149	11.97486	.08037		
TOTAL	154	183.95082			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	-.0125	(-.6549 , .6300)	-.0051	(-.1335 , .1233)
3	.0363	(-.6067 , .6794)	.0002	(-.1286 , .1291)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR COBALT ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1	
AMPUL NO:	1	2	1	2
TRUE CONC:	30.20	24.80	30.20	24.80
LAB NUMBER				
1	30.10	25.00	33.83	28.09
2	28.80	22.70	33.00	21.00
3	32.50	23.00	29.00	24.30
4	22.10	17.60	21.00	30.00
5	44.10*	31.90*	43.00	31.00
6	27.80	26.00	37.00*	31.00*
7	30.70	24.40	32.00	23.00
8	22.10	21.80	25.00	27.00
9	21.00	24.10	30.90*	32.90*
10	28.80	29.40	35.00	25.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR COBALT ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1	
AMPUL NO:	3	4	3	4
TRUE CONC:	203.00	164.00	203.00	164.00
LAB NUMBER				
1	225.00	181.00	208.00	164.00
2	177.00	141.00	203.00	167.00
3	213.00	147.00	198.00	138.00
4	174.00	137.00	160.00	200.00
5	214.00*	179.00*	110.00	26.00*
6	245.00	193.00	253.00*	227.00*
7	192.00	149.00	160.00	126.00
8	153.00	114.00	180.00	154.00
9	158.00	164.00	386.00*	235.00*
10	98.00	76.00	250.00	160.00

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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR COBALT ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1	
AMPUL NO:	5	6	5	6
TRUE CONC:	309.00	407.00	309.00	407.00
LAB NUMBER				
1	287.00	395.00	289.00	382.00
2	304.00	406.00	312.00	373.00
3	359.00	361.00	306.00	318.00
4	274.00	338.00	340.00	420.00
5	428.00*	550.00*	214.00	394.00
6	346.00	524.00	367.00*	444.00*
7	280.00	393.00	190.00	252.00
8	277.00	317.00	290.00	380.00
9	250.00	382.00	541.00*	667.00*
10	152.00	163.00	160.00	400.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR COBALT ANALYSES BY WATER TYPE

	WATER 1		WATER 2	
LOW YOUDEN PAIR	1	2	1	2
NUMBER OF DATA POINTS	9	9	8	8
TRUE CONC (C) UG/L	30.20	24.80	30.20	24.80
MEAN RECOVERY (X)	27.10	23.78	31.48	26.17
ACCURACY(%REL ERROR)	-10.26	-4.12	4.23	5.54
OVERALL STD DEV (S)	4.25	3.21	6.67	3.46
OVERALL REL STD DEV, %	15.69	13.50	21.18	13.24
SINGLE STD DEV, (SR)	2.82		5.24	
ANALYST REL DEV, %	11.09		18.17	
MEDIUM YOUDEN PAIR	3	4	3	4
NUMBER OF DATA POINTS	9	9	8	7
TRUE CONC (C) UG/L	203.00	164.00	203.00	164.00
MEAN RECOVERY (X)	181.67	144.67	183.63	158.43
ACCURACY(%REL ERROR)	-10.51	-11.79	-9.54	-3.40
OVERALL STD DEV (S)	43.93	34.97	41.63	23.54
OVERALL REL STD DEV, %	24.18	24.17	22.67	14.86
SINGLE STD DEV, (SR)	14.21		28.04	
ANALYST REL DEV, %	8.71		16.40	
HIGH YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	9	9	8	8
TRUE CONC (C) UG/L	309.00	407.00	309.00	407.00
MEAN RECOVERY (X)	281.00	364.33	262.63	364.88
ACCURACY(%REL ERROR)	-9.06	-10.48	-15.01	-10.35
OVERALL STD DEV (S)	59.73	95.38	65.38	54.31
OVERALL REL STD DEV, %	21.26	26.18	24.89	14.88
SINGLE STD DEV, (SR)	41.28		51.56	
ANALYST REL DEV, %	12.79		16.43	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 1

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON COBALT ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .97650

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.3144	-.0479

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	110.50401	110.50401		
REG(WATER/DISTILLED)	2	.21979	.10990	2.65	.0763
ERROR	88	3.64980	.04148		
TOTAL	91	114.37361			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERCEPT(WATER-DISTILLED) INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	SLOPE(WATER-DISTILLED) INTERVAL
2	.3144	(-.0957 , .7244)	-.0479	(-.1309 , .0350)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR CORALT ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 2	
AMPUL NO:	1	2	1	2
TRUE CONC:	21.10	25.00	21.10	25.00
LAB NUMBER				
1	21.00	25.00	21.70	25.50
2	20.10	22.70	21.00	19.00
3	15.40	23.00	21.10	21.10
4	15.40	17.60	18.00	19.00
5	30.80*	31.90*	27.00	26.00
6	19.40	26.00	31.00*	38.00*
7	21.40	24.40	19.00	20.00
8	15.40	21.80	31.00	14.00
9	14.70	24.10	19.60	28.40
10	20.10	29.40	15.00*	20.00*

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR COBALT ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 2	
AMPUL NO:	3	4	3	4
TRUE CONC:	250.00	212.00	250.00	212.00
LAB NUMBER				
1	276.00	233.00	270.00	237.00
2	217.00	182.00	239.00	198.00
3	261.00	189.00	191.00	199.00
4	214.00	176.00	210.00	450.00*
5	263.00*	231.00*	243.00	187.00
6	302.00	249.00	271.00*	221.00*
7	236.00	192.00	210.00	176.00
8	188.00	147.00	300.00	210.00
9	194.00	212.00	252.00	200.00
10	121.00	98.00	200.00*	150.00*

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR COBALT ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 2	
AMPUL NO:	5	6	5	6
TRUE CONC:	461.00	403.00	461.00	403.00
LAB NUMBER				
1	415.00	389.00	435.00	392.00
2	440.00	399.00	473.00	308.00
3	519.00	356.00	350.00	363.00
4	396.00	333.00	450.00	400.00
5	619.00*	541.00*	593.00	451.00
6	501.00	516.00	497.00*	447.00*
7	405.00	387.00	396.00	362.00
8	400.00	312.00	370.00	380.00
9	362.00	376.00	474.00	434.00
10	220.00	160.00	250.00*	200.00*

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR COBALT ANALYSES BY WATER TYPE

	WATER 1		WATER 2	
LOW YOUDEN PAIR	1	2	1	2
NUMBER OF DATA POINTS	9	9	8	8
TRUE CONC (C) UG/L	21.10	25.00	21.10	25.00
MEAN RECOVERY (X)	18.10	23.78	22.30	21.62
ACCURACY(%REL ERROR)	-14.22	-4.89	5.69	-13.50
OVERALL STD DEV (S)	2.79	3.21	4.44	4.70
OVERALL REL STD DEV, %	15.43	13.50	19.91	21.75
SINGLE STD DEV, (SR)	1.99		5.24	
ANALYST REL DEV, %	9.52		23.85	
MEDIUM YOUDEN PAIR	3	4	3	4
NUMBER OF DATA POINTS	9	9	8	7
TRUE CONC (C) UG/L	250.00	212.00	250.00	212.00
MEAN RECOVERY (X)	223.22	186.44	239.38	201.00
ACCURACY(%REL ERROR)	-10.71	-12.05	-4.25	-5.19
OVERALL STD DEV (S)	53.91	45.11	35.56	19.20
OVERALL REL STD DEV, %	24.15	24.19	14.86	9.55
SINGLE STD DEV, (SR)	17.33		20.90	
ANALYST REL DEV, %	8.46		9.49	
HIGH YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	9	9	8	8
TRUE CONC (C) UG/L	461.00	403.00	461.00	403.00
MEAN RECOVERY (X)	406.44	358.67	442.63	386.25
ACCURACY(%REL ERROR)	-11.83	-11.00	-3.99	-4.16
OVERALL STD DEV (S)	86.38	94.02	76.21	44.70
OVERALL REL STD DEV, %	21.25	26.21	17.22	11.57
SINGLE STD DEV, (SR)	39.08		45.78	
ANALYST REL DEV, %	10.22		11.05	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 2

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON COBALT ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .98610

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	-.0343	.0156

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	160.33999	160.33999		
REG(WATER/DISTILLED)	2	.04642	.02321	.79	.4584
ERROR	88	2.59586	.02950		
TOTAL	91	162.98227			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	-.0343	(-.3408 , .2723)	.0156	(-.0448 , .0761)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR COBALT ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 3	
AMPUL NO:	1	2	1	2
TRUE CONC:	29.30	34.70	29.30	34.70
LAB NUMBER				
1	29.20	34.80	21.40	26.50
2	27.90	31.60	24.00	24.00
3	31.40	32.10	30.80	25.40
4	21.40	24.60	27.00	33.00
5	42.80*	44.50*	46.00*	45.00*
6	28.80	36.30	49.00*	42.00*
7	27.00	33.90	29.00	30.00
8	24.20	30.40	27.00	18.00
9	20.40	33.60	36.40	35.10
10	27.90	41.00	20.00	55.00*

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR COBALT ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 3	
AMPUL NO:	3	4	3	4
TRUE CONC:	211.00	166.00	211.00	166.00
LAB NUMBER				
1	233.00	183.00	196.00	156.00
2	183.00	143.00	167.00	138.00
3	220.00	149.00	194.00	135.00
4	181.00	139.00	200.00	160.00
5	221.00*	182.00*	233.00*	169.00*
6	254.00	196.00	242.00*	205.00*
7	199.00	151.00	157.00	125.00
8	158.00	116.00	200.00	390.00*
9	164.00	166.00	169.00	157.00
10	102.00	77.00	160.00	50.00*

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR CORALT ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 3	
AMPUL NO:	5	6	5	6
TRUE CONC:	435.00	326.00	435.00	326.00
LAB NUMBER				
1	393.00	316.00	398.00	304.00
2	416.00	325.00	1060.00*	839.00*
3	491.00	289.00	345.00	261.00
4	374.00	270.00	420.00	320.00
5	586.00*	440.00*	452.00*	340.00*
6	473.00	419.00	441.00*	324.00*
7	383.00	314.00	298.00	218.00
8	379.00	254.00	310.00	270.00
9	342.00	306.00	396.00	254.00
10	208.00	130.00	150.00	50.00*

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR COBALT ANALYSES BY WATER TYPE

	WATER 1		WATER 2	
LOW YOUDEN PAIR	1	2	1	2
NUMBER OF DATA POINTS	9	9	8	7
TRUE CONC (C) UG/L	29.30	34.70	29.30	34.70
MEAN RECOVERY (X)	26.47	33.14	26.95	27.43
ACCURACY(%REL ERROR)	-9.67	-4.48	-8.02	-20.96
OVERALL STD DEV (S)	3.70	4.46	5.29	5.80
OVERALL REL STD DEV, %	13.96	13.46	19.64	21.16
SINGLE STD DEV, (SR)	2.99		3.80	
ANALYST REL DEV, %	10.02		13.97	
MEDIUM YOUDEN PAIR	3	4	3	4
NUMBER OF DATA POINTS	9	9	8	6
TRUE CONC (C) UG/L	211.00	166.00	211.00	166.00
MEAN RECOVERY (X)	188.22	146.67	180.38	145.17
ACCURACY(%REL ERROR)	-10.80	-11.65	-14.51	-12.55
OVERALL STD DEV (S)	45.38	35.39	18.78	14.41
OVERALL REL STD DEV, %	24.11	24.13	10.41	9.93
SINGLE STD DEV, (SR)	14.63		10.95	
ANALYST REL DEV, %	8.74		6.73	
HIGH YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	9	9	7	6
TRUE CONC (C) UG/L	435.00	326.00	435.00	326.00
MEAN RECOVERY (X)	384.33	291.44	331.00	271.17
ACCURACY(%REL ERROR)	-11.65	-10.60	-23.91	-16.82
OVERALL STD DEV (S)	81.65	76.36	92.31	36.58
OVERALL REL STD DEV, %	21.25	26.20	27.89	13.49
SINGLE STD DEV, (SR)	34.33		23.36	
ANALYST REL DEV, %	10.16		7.76	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 3

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON COBALT ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .97208

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	-.0614	.0001

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	100.44051	100.44051		
REG(WATER/DISTILLED)	2	.08265	.04133	1.30	.2779
ERROR	84	2.66309	.03170		
TOTAL	87	103.18626			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	-.0614	(-.4484 , .3256)	.0001	(-.0779 , .0780)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE ORTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR COPPER ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	1	2	1	2	1	2
TRUE CONC:	10.60	12.20	10.60	12.20	10.60	12.20
LAB NUMBER						
1	10.35	11.82	44.00	23.50	13.00	15.40
2	15.00	17.00	< 8.00*	< 8.00*	38.00*	12.00
3	9.30	10.20	15.00	14.40	11.30	9.70
4	9.00	11.00	9.00	12.00	9.00	8.00
5	5.00	9.00	32.00	22.00	14.00	8.00
6	16.00	11.00	14.00	15.00	12.00	13.00
7	10.00	15.00	- 22.00*	8.00*	15.00	7.00
8	4.40	5.60	8.70	4.60	5.80	4.30
9	2.40*	3.50*	12.80	11.30	2.70*	3.60*
10	11.00	14.00	11.00	11.00	14.00	14.00

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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR COPPER ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER			DRINKING WATER		SURFACE WATER	
AMPUL NO:	3	4		3	4	3	4
TRUE CONC:	72.70	97.30		72.70	97.30	72.70	97.30
LAB NUMBER							
1	88.00*	109.00		79.00	90.00	64.20	88.00
2	71.00	104.00	<	8.00*	0.00*	66.00	87.00
3	73.00	95.80		73.30	93.20	70.50	86.00
4	68.00	87.00		68.00	89.00	61.00	85.00
5	73.00	77.00		17.00	20.00	96.00	128.00
6	71.00	115.00		218.00*	171.00	107.00	118.00
7	70.00	94.00		38.00*	38.00*	53.00	77.00
8	69.30	53.30		63.00	84.00	63.60	59.70
9	29.40*	38.40*		42.50	56.90	33.40*	48.20*
10	78.00	98.00		61.00	86.00	80.00	90.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR COPPER ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	5	6	5	6	5	6
TRUE CONC:	205.00	245.00	205.00	245.00	205.00	245.00
LAB NUMBER						
1	198.20	247.30	195.00	254.00	211.00	244.00
2	407.00	232.00	200.00	295.00	216.00	230.00
3	202.00	246.00	174.00	202.00	192.00	242.00
4	180.00	200.00	190.00	230.00	200.00	220.00
5	111.00	212.00	386.00	352.00	262.00	309.00
6	216.00	262.00	243.00	269.00	267.00	346.00
7	15.00	17.00*	148.00*	148.00*	172.00	192.00
8	185.00	222.00	170.00	210.00	209.00	245.00
9	59.00*	64.00*	388.00	176.00	100.00*	119.00*
10	208.00	268.00	206.00	256.00	205.00	235.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR COPPER ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3	
LOW YOUDEN PAIR	1	2	1	2	1	2
NUMBER OF DATA POINTS	9	9	8	8	8	9
TRUE CONC (C) UG/L	10.60	12.20	10.60	12.20	10.60	12.20
MEAN RECOVERY (X)	10.01	11.62	18.31	14.22	11.76	10.16
ACCURACY(%REL ERROR)	-5.61	-4.72	72.76	16.60	10.97	-16.76
OVERALL STD DEV (S)	3.87	3.39	12.76	6.14	3.06	3.67
OVERALL REL STD DEV, %	38.70	29.17	69.68	43.14	26.00	36.10
SINGLE STD DEV, (SR)	2.00		5.45		2.47	
ANALYST REL DEV, %	18.47		33.51		22.56	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4
NUMBER OF DATA POINTS	8	9	7	8	9	9
TRUE CONC (C) UG/L	72.70	97.30	72.70	97.30	72.70	97.30
MEAN RECOVERY (X)	71.66	92.57	57.69	86.26	73.48	90.97
ACCURACY(%REL ERROR)	-1.43	-4.86	-20.65	-11.34	1.07	-6.51
OVERALL STD DEV (S)	3.08	18.58	21.33	42.27	17.67	20.50
OVERALL REL STD DEV, %	4.30	20.07	36.98	49.00	24.04	22.53
SINGLE STD DEV, (SR)	12.85		5.33		7.53	
ANALYST REL DEV, %	15.65		7.41		9.16	
HIGH YOUDEN PAIR	5	6	5	6	5	6
NUMBER OF DATA POINTS	9	8	9	9	9	9
TRUE CONC (C) UG/L	205.00	245.00	205.00	245.00	205.00	245.00
MEAN RECOVERY (X)	191.36	236.16	239.11	249.33	214.89	251.44
ACCURACY(%REL ERROR)	-6.66	-3.61	16.64	1.77	4.82	2.63
OVERALL STD DEV (S)	103.24	23.94	86.43	53.17	30.96	47.03
OVERALL REL STD DEV, %	53.95	10.14	36.15	21.33	14.41	18.70
SINGLE STD DEV, (SR)	58.87		63.65		14.15	
ANALYST REL DEV, %	27.54		26.06		6.07	

WATER LEGEND

1 - LAB PURE WATER
2 - DRINKING WATER
3 - SURFACE WATER

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON COPPER ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .98393

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.4070	-.0696
3	-.1206	.0481

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	228.67460	228.67460		
REG(WATER/DISTILLED)	4	.89276	.22319	1.49	.2083
ERROR	139	20.81268	.14973		
TOTAL	144	250.38004			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERCEPT(WATER-DISTILLED) INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	SLOPE(WATER-DISTILLED) INTERVAL
2	.4070	(-.2579 , 1.0719)	-.0696	(-.2233 , .0840)
3	-.1206	(-.7709 , .5297)	.0481	(-.1039 , .2001)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR COPPER ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 3	
AMPUL NO:	1	2	1	2	1	2
TRUE CONC:	10.10	11.70	10.10	11.70	10.10	11.70
LAB NUMBER						
1	*	*	9.89	11.29	2.90*	12.80*
2	17.60*	21.70*	14.30	16.20	< 8.00*	< 8.00*
3	3.00	12.00	8.90	9.70	< 3.90*	< 3.90*
4	3.90	16.30	8.60	10.50	3.00	2.00
5	14.00	15.00	4.80	8.60	16.00	< 1.00*
6	10.00	2.00	15.30	10.50	10.00	12.00
7	19.00	14.00	9.60	14.30	- 12.00*	- 12.00*
8	6.00	7.00	4.20	5.40	23.20	16.30
9	2.80	4.90	2.30*	3.30*	1.20	4.00
10	0.50* -	1.70*	10.50	13.40	5.00	< 1.00*

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR COPPER ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 3	
AMPUL NO:	3	4	3	4	3	4
TRUE CONC:	69.60	93.00	69.60	93.00	69.60	93.00
LAB NUMBER						
1	*	*	84.10*	104.00	98.40*	132.00*
2	111.00*	138.00*	67.80	99.30	33.00	60.00
3	67.00	90.00	69.70	91.50	35.30	55.30
4	67.50	91.10	65.00	83.10	94.00	84.00
5	78.00	93.00	69.70	73.50	94.00	86.00
6	79.00	89.00	67.80	110.00	64.00	83.00
7	65.00	92.00	66.90	89.80	18.00	48.00
8	53.00	69.00	66.20	50.90	78.00	91.00
9	33.50	77.30	28.10*	36.70*	18.00	25.80
10	23.00*	34.70*	75.00	94.00	55.00	75.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR COPPER ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 3	
AMPUL NO:	5	6	5	6	5	6
TRUE CONC:	196.00	234.00	196.00	234.00	196.00	234.00
LAB NUMBER						
1	*	*	189.00	236.00	307.00*	353.00*
2	292.00*	361.00*	389.00	222.00	139.00	175.00
3	202.00	210.00	193.00	235.00	123.00	164.00
4	146.00	197.00	172.00	191.00	200.00	310.00
5	200.00	240.00	106.00	202.00	195.00	315.00
6	176.00	38.00*	206.00	250.00	177.00	214.00
7	195.00	232.00	14.30	16.20*	168.00	208.00
8	153.00	263.00	177.00	212.00	170.00	228.00
9	141.00	189.00	56.40*	61.00*	102.00	122.00
10	92.00*	112.00*	199.00	256.00	195.00	225.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR COPPER ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3	
LOW YOUDEN PAIR	1	2	1	2	1	2
NUMBER OF DATA POINTS	7	7	9	9	6	4
TRUE CONC (C) UG/L	10.10	11.70	10.10	11.70	10.10	11.70
MEAN RECOVERY (X)	8.39	10.17	9.57	11.10	9.73	8.57
ACCURACY(%REL ERROR)	-16.97	-13.06	-5.29	-5.14	-3.63	-26.71
OVERALL STD DEV (S)	6.23	5.53	3.69	3.22	8.50	6.72
OVERALL REL STD DEV, %	74.28	54.37	38.62	29.02	87.33	78.39
SINGLE STD DEV, (SR)	5.06		1.91		3.11	
ANALYST REL DEV, %	54.59		18.44		33.98	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4
NUMBER OF DATA POINTS	7	7	8	9	9	9
TRUE CONC (C) UG/L	69.60	93.00	69.60	93.00	69.60	93.00
MEAN RECOVERY (X)	63.29	85.91	68.51	88.46	54.37	67.57
ACCURACY(%REL ERROR)	-9.07	-7.62	-1.56	-4.89	-21.89	-27.35
OVERALL STD DEV (S)	15.76	9.13	3.08	17.78	30.12	21.76
OVERALL REL STD DEV, %	24.91	10.63	4.49	20.10	55.40	32.20
SINGLE STD DEV, (SR)	7.80		12.30		10.05	
ANALYST REL DEV, %	10.46		15.67		16.48	
HIGH YOUDEN PAIR	5	6	5	6	5	6
NUMBER OF DATA POINTS	7	6	9	8	9	9
TRUE CONC (C) UG/L	196.00	234.00	196.00	234.00	196.00	234.00
MEAN RECOVERY (X)	173.29	221.83	182.81	225.50	163.22	217.89
ACCURACY(%REL ERROR)	-11.59	-5.20	-6.73	-3.63	-16.72	-6.89
OVERALL STD DEV (S)	26.51	28.15	99.68	22.89	34.61	63.36
OVERALL REL STD DEV, %	15.30	12.69	53.98	10.15	21.21	29.08
SINGLE STD DEV, (SR)	23.73		56.13		25.27	
ANALYST REL DEV, %	12.01		27.49		13.26	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 1
3 - EFFLUENT 3

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON COPPER ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = 1.10921

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.4282	-.1241
3	-.1881	-.0059

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	225.27030	225.27030		
REG(WATER/DISTILLED)	4	1.53943	.38486	1.79	.1346
ERROR	124	26.63094	.21477		
TOTAL	129	253.44067			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	.4282	(-.3942 , 1.2505)	-.1241	(-.3185 , .0703)
3	-.1881	(-1.1104 , .7343)	-.0059	(-.2181 , .2063)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR COPPER ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - MG/L

	LAB PURE WATER		EFFLUENT 2	
AMPUL NO:	1	2	1	2
TRUE CONC:	0.36	0.30	0.36	0.30
LAB NUMBER				
1	0.39	0.30	0.31	0.27
2	0.39	0.38	0.24	0.21
3	0.30	0.23	0.32	0.27
4	0.29	0.28	0.24	0.22
5	0.35	0.27	0.49*	0.44*
6	0.28	0.30	0.26	0.25
7	0.03*	0.02*	0.24	0.19
8	0.32	0.27	0.50*	0.28
9	0.11*	0.15*	0.22*	0.12*
10	0.32	0.30	0.25	0.30

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR COPPER ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - MG/L

	LAB PURE WATER		EFFLUENT 2	
AMPUL NO:	3	4	3	4
TRUE CONC:	0.65	0.55	0.65	0.55
LAB NUMBER				
1	0.65	0.56	0.61	0.52
2	0.72	0.56	0.53	0.63
3	0.66	0.57	0.72	0.58
4	0.41	0.33*	0.41	0.51
5	0.54	0.56	0.79*	0.71*
6	0.55	0.54	0.54	0.48
7	0.06*	0.05*	0.30	0.37
8	0.57	0.50	0.64	0.53
9	0.26*	0.01*	0.46*	0.35*
10	0.65	0.54	0.50	0.50

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR COPPER ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - MG/L

	LAB PURE WATER		EFFLUENT 2	
AMPUL NO:	5	6	5	6
TRUE CONC:	1.30	1.67	1.30	1.67
LAB NUMBER				
1	1.40	1.78	1.45	1.74
2	1.38	1.44	1.29	1.67
3	1.35	1.88	1.29	1.70
4	1.19	1.19	1.10	1.50
5	1.18	1.51	1.60*	1.81*
6	1.21	1.41	1.07	1.43
7	0.11*	0.13*	1.20	1.50
8	1.07	1.23	1.36	1.64
9	0.77*	0.81*	1.01*	0.95*
10	1.08	1.83	1.60	1.80

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR COPPER ANALYSES BY WATER TYPE

	WATER 1		WATER 2	
LOW YOUDEN PAIR	1	2	1	2
NUMBER OF DATA POINTS	8	8	7	8
TRUE CONC (C) MG/L	0.36	0.30	0.36	0.30
MEAN RECOVERY (X)	0.33	0.29	0.27	0.25
ACCURACY(%REL ERROR)	-7.54	-3.42	-25.66	-17.53
OVERALL STD DEV (S)	0.04	0.04	0.03	0.04
OVERALL REL STD DEV, %	12.85	14.35	12.99	15.66
SINGLE STD DEV, (SR)	0.03		0.02	
ANALYST REL DEV, %	8.23		9.45	
MEDIUM YOUDEN PAIR	3	4	3	4
NUMBER OF DATA POINTS	8	7	8	8
TRUE CONC (C) MG/L	0.65	0.55	0.65	0.55
MEAN RECOVERY (X)	0.60	0.55	0.53	0.51
ACCURACY(%REL ERROR)	-8.06	-1.19	-17.79	-7.06
OVERALL STD DEV (S)	0.10	0.02	0.13	0.08
OVERALL REL STD DEV, %	16.28	4.41	25.02	14.64
SINGLE STD DEV, (SR)	0.04		0.07	
ANALYST REL DEV, %	7.69		13.16	
HIGH YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	8	8	8	8
TRUE CONC (C) MG/L	1.30	1.67	1.30	1.67
MEAN RECOVERY (X)	1.23	1.53	1.30	1.62
ACCURACY(%REL ERROR)	-5.27	-8.14	-0.36	-2.85
OVERALL STD DEV (S)	0.13	0.27	0.18	0.13
OVERALL REL STD DEV, %	10.71	17.50	13.65	8.07
SINGLE STD DEV, (SR)	0.18		0.05	
ANALYST REL DEV, %	12.90		3.52	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 2

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON COPPER ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .98485

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.0229	.1532

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	41.46190	41.46190		
REG(WATER/DISTILLED)	2	.24674	.12337	7.89	.0007
ERROR	82	1.28151	.01563		
TOTAL	85	42.99015			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERCEPT(WATER-DISTILLED) INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	SLOPE(WATER-DISTILLED) INTERVAL
2	.0229	(-.0492 , .0950)	.1532	(.0610 , .2455)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR IRON ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	1	2	1	2	1	2
TRUE CONC:	31.80	26.10	31.80	26.10	31.80	26.10
LAB NUMBER						
1	50.70	44.00	166.00	105.00*	- 104.00*	177.00
2	214.00	243.00*	142.00	< 11.00*	< 10.00*	< 10.00*
3	30.60	26.60	34.00	23.40	720.00*	< 20.00*
4	13.00	12.00	- 40.00*	20.00	620.00*	720.00*
5	69.00	29.00	< 8.00*	< 8.00*	86.00	51.00
6	28.00	29.00	26.00	14.00	132.00	185.00
7	76.00	76.00	96.00	56.00	250.00	250.00
8	< 3.00*	6.00*	60.00	7.00	175.00	59.00
9	187.00	13.00	26.70	21.60	- 13.90*	23.90
100	37.00	37.00	35.00	35.00	100.00	50.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR IRON ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	3	4	3	4	3	4
TRUE CONC:	236.00	200.00	236.00	200.00	236.00	200.00
LAB NUMBER						
1	243.30	292.30	349.00	331.00	404.00	315.00
2	332.00	218.00	375.00	10.00	550.00	497.00
3	553.00	290.00	286.00	334.00	< 20.00*	< 20.00*
4	660.00	311.00	170.00	570.00	920.00*	720.00*
5	816.00	311.00	48.00	140.00	75.00	261.00
6	203.00	198.00	228.00	245.00	260.00	211.00
7	136.00	286.00	346.00	256.00	470.00	520.00
8	178.00*	166.00*	288.00	363.00	462.00	269.00
9	4283.00*	86.00*	237.00	177.00	199.00	319.00
10	292.00	272.00	320.00	350.00	250.00	200.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR IRON ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	5	6	5	6	5	6
TRUE CONC:	455.00	389.00	455.00	389.00	455.00	389.00
LAB NUMBER						
1	496.30	422.30	625.00	533.00	889.00	417.00
2	497.00	1070.00	44.00*	< 11.00*	577.00	1090.00
3	432.00	530.00	554.00	1150.00*	180.00	< 20.00*
4	450.00	541.00	480.00	330.00	1000.00*	920.00*
5	620.00	655.00	727.00	540.00	321.00	504.00
6	433.00	353.00	353.00	343.00	317.00	307.00
7	396.00	396.00	536.00	536.00	600.00	390.00
8	432.00*	403.00*	511.00	259.00	611.00	728.00
9	530.00	839.00	469.00	434.00	685.00	- 42.00*
10	442.00	492.00	620.00	470.00	600.00	500.00

ENVIRONMENTAL MONITORING AND SUPPORT LAROATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR IRON ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3	
LOW YOUDEN PAIR	1	2	1	2	1	2
NUMBER OF DATA POINTS	9	8	8	7	5	7
TRUE CONC (C) UG/L	31.80	26.10	31.80	26.10	31.80	26.10
MEAN RECOVERY (X)	78.37	33.32	73.21	25.29	148.60	113.69
ACCURACY(%REL ERROR)	146.44	27.68	130.23	-3.12	367.30	335.58
OVERALL STD DEV (S)	72.34	20.35	55.32	16.04	66.21	88.25
OVERALL REL STD DEV, %	92.30	61.07	75.57	63.45	44.56	77.63
SINGLE STD DEV, (SR)	42.78		15.04		44.17	
ANALYST REL DEV, %	76.61		30.55		33.68	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4
NUMBER OF DATA POINTS	8	8	10	10	8	8
TRUE CONC (C) UG/L	236.00	200.00	236.00	200.00	236.00	200.00
MEAN RECOVERY (X)	404.41	272.29	264.70	277.60	333.75	324.00
ACCURACY(%REL ERROR)	71.36	36.14	12.16	38.80	41.42	62.00
OVERALL STD DEV (S)	242.97	42.03	98.87	151.39	162.25	121.65
OVERALL REL STD DEV, %	60.08	15.44	37.35	54.53	48.61	37.55
SINGLE STD DEV, (SR)	156.90		133.58		86.03	
ANALYST REL DEV, %	46.37		49.26		26.16	
HIGH YOUDEN PAIR	5	6	5	6	5	6
NUMBER OF DATA POINTS	9	9	9	8	9	7
TRUE CONC (C) UG/L	455.00	389.00	455.00	389.00	455.00	389.00
MEAN RECOVERY (X)	477.37	588.70	541.67	430.63	531.11	562.29
ACCURACY(%REL ERROR)	4.92	51.34	19.05	10.70	16.73	44.55
OVERALL STD DEV (S)	67.55	232.95	107.95	108.48	218.81	267.45
OVERALL REL STD DEV, %	14.15	39.57	19.93	25.19	41.20	47.57
SINGLE STD DEV, (SR)	147.00		64.00		221.22	
ANALYST REL DEV, %	27.58		13.16		40.47	

WATER LEGEND

1 - LAB PURE WATER
2 - DRINKING WATER
3 - SURFACE WATER

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON IRON ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .95790

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	-.1970	.0051
3	2.2718	-.4042

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	129.11791	129.11791		
REG(WATER/DISTILLED)	4	9.71488	2.42872	6.74	.0001
ERROR	132	47.58961	.36053		
TOTAL	137	186.42239			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERCEPT(WATER-DISTILLED) INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	SLOPE(WATER-DISTILLED) INTERVAL
2	-.1970	(-1.5561 , 1.1622)	.0051	(-.2607 , .2709)
3	2.2718	(.8452 , 3.6983)	-.4042	(-.6805 , -.1279)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR IRON ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - MG/L

	LAB PURE WATER		EFFLUENT 1	
AMPUL NO:	1	2	1	2
TRUE CONC:	1.03	1.22	1.03	1.22
LAB NUMBER				
1	1.48	1.60	1.10	1.23
2	0.94	0.50	0.96	0.94
3	1.82	1.53	0.74	0.82
4	1.03	1.19	1.70	1.10
5	1.18	1.11	0.47	0.21*
6	1.16	1.39	0.91	1.23
7	0.74	0.93	0.60	1.45
8	1.00	0.79	0.91	1.20
9	3.13*	5.88*	1.09	0.96
10	1.26	1.35	0.80	1.00

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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR IRON ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - MG/L

	LAB PURE WATER		EFFLUENT 1	
AMPUL NO:	3	4	3	4
TRUE CONC:	2.18	2.58	2.18	2.58
LAB NUMBER				
1	2.48	3.35	2.00	2.60
2	2.60	2.10	10.00*	9.71
3	1.89	2.31	1.67	7.39
4	2.27	2.69	2.90	2.50
5	1.97	2.30	2.09	1.06
6	2.50	3.00	2.07	2.61
7	2.51	2.72	1.58	1.60
8	2.52	2.81	2.88	3.29
9	2.55	2.98	1.52	1.73
10	2.85	2.93	1.70	3.20

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR IRON ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - MG/L

	LAB PURE WATER		EFFLUENT 1	
AMPUL NO:	5	6	5	6
TRUE CONC:	4.78	5.59	4.78	5.59
LAB NUMBER				
1	4.85	5.39	4.05	5.21
2	4.75	5.88	3.80	3.92
3	3.96	4.61	3.84	4.22
4	5.17	5.80	5.80	6.80
5	5.56	5.85	6.93	5.58
6	5.12	5.86	4.67	5.07
7	4.75	6.21	4.12	5.22
8	4.84	5.07	7.19	8.87
9	4.04	4.36	4.84	5.51
10	5.62	6.71	4.20	6.20

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR IRON ANALYSES BY WATER TYPE

	WATER 1		WATER 2	
LOW YOUDEN PAIR	1	2	1	2
NUMBER OF DATA POINTS	9	9	10	9
TRUE CONC (C) MG/L	1.03	1.22	1.03	1.22
MEAN RECOVERY (X)	1.18	1.15	0.93	1.10
ACCURACY(%REL ERROR)	14.42	-5.33	-9.85	-9.52
OVERALL STD DEV (S)	0.32	0.36	0.34	0.19
OVERALL REL STD DEV, %	27.03	31.38	36.34	17.53
SINGLE STD DEV, (SR)	0.17		0.28	
ANALYST REL DEV, %	14.46		27.06	
MEDIUM YOUDEN PAIR	3	4	3	4
NUMBER OF DATA POINTS	10	10	9	10
TRUE CONC (C) MG/L	2.18	2.58	2.18	2.58
MEAN RECOVERY (X)	2.41	2.72	2.05	3.57
ACCURACY(%REL ERROR)	10.72	5.41	-6.15	38.34
OVERALL STD DEV (S)	0.29	0.38	0.52	2.77
OVERALL REL STD DEV, %	12.06	14.13	25.52	77.62
SINGLE STD DEV, (SR)	0.25		1.38	
ANALYST REL DEV, %	9.66		49.33	
HIGH YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	10	10	10	10
TRUE CONC (C) MG/L	4.78	5.59	4.78	5.59
MEAN RECOVERY (X)	4.87	5.57	4.94	5.66
ACCURACY(%REL ERROR)	1.86	-0.27	3.45	1.26
OVERALL STD DEV (S)	0.55	0.72	1.26	1.41
OVERALL REL STD DEV, %	11.35	12.93	25.54	24.82
SINGLE STD DEV, (SR)	0.29		0.66	
ANALYST REL DEV, %	5.48		12.44	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 1

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON IRON ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .99617

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	-.1542	.1005

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	50.14372	50.14372		
REG(WATER/DISTILLED)	2	.23333	.11666	1.36	.2619
ERROR	103	8.85215	.08594		
TOTAL	106	59.22920			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	-.1542	(-.3672 , .0589)	.1005	(-.0940 , .2951)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR IRON ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - MG/L

	LAB PURE WATER		EFFLUENT 2	
AMPUL NO:	1	2	1	2
TRUE CONC:	0.42	0.37	0.42	0.37
LAB NUMBER				
1	0.60	0.49	0.44	0.38
2	0.38	0.15 <	0.01*	0.38
3	0.74	0.47	0.44 <	0.02*
4	0.42	0.36	0.42	0.39
5	0.48	0.34	0.65 -	0.18*
6	0.47	0.42	0.35	0.28
7	0.30	0.28	0.52	0.54
8	0.41	0.24	0.51	1.03*
9	1.27*	1.80*	1.05*	1.01*
10	0.51	0.41	0.35	0.45

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR IRON ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - MG/L

	LAB PURE WATER		EFFLUENT 2	
AMPUL NO:	3	4	3	4
TRUE CONC:	0.88	0.95	0.88	0.95
LAB NUMBER				
1	1.00	1.24	0.86	1.04
2	1.05	0.77	0.83	0.96
3	0.76	0.85	0.71	0.96
4	0.92	0.99	1.10	1.00
5	0.80	0.85	1.15	0.11*
6	1.01	1.11	0.84	0.96
7	1.02	1.00	0.93	0.79
8	1.02	1.04	1.71*	1.32*
9	1.03	1.10	1.38*	1.55*
10	1.15	1.08	0.90	0.90

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR IRON ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - MG/L

	LAB PURE WATER		EFFLUENT 2	
AMPUL NO:	5	6	5	6
TRUE CONC:	2.61	2.05	2.61	2.05
LAB NUMBER				
1	4.85	1.99	2.93	1.73
2	4.75	2.17	2.03	1.81
3	3.96	1.70	2.15	1.62
4	5.17	2.14	3.00	2.30
5	5.56	2.16	3.61	2.63
6	5.12	2.16	2.45	2.65
7	4.75	2.29	1.80	1.70
8	4.84	1.87	2.81	3.74
9	4.04	1.61	3.51*	5.71*
10	5.62	2.48	2.30	1.70

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR IRON ANALYSES BY WATER TYPE

	WATER 1		WATER 2	
LOW YOUDEN PAIR	1	2	1	2
NUMBER OF DATA POINTS	9	9	8	6
TRUE CONC (C) MG/L	0.42	0.37	0.42	0.37
MEAN RECOVERY (X)	0.48	0.35	0.46	0.40
ACCURACY(%REL ERROR)	13.65	-3.99	9.67	9.42
OVERALL STD DEV (S)	0.13	0.11	0.10	0.09
OVERALL REL STD DEV, %	27.00	31.41	21.54	21.52
SINGLE STD DEV, (SR)	0.06		0.05	
ANALYST REL DEV, %	14.38		11.49	
MEDIUM YOUDEN PAIR	3	4	3	4
NUMBER OF DATA POINTS	10	10	8	7
TRUE CONC (C) MG/L	0.88	0.95	0.88	0.95
MEAN RECOVERY (X)	0.98	1.00	0.91	0.94
ACCURACY(%REL ERROR)	11.28	5.44	4.14	-0.78
OVERALL STD DEV (S)	0.12	0.14	0.15	0.08
OVERALL REL STD DEV, %	12.06	14.13	15.93	8.59
SINGLE STD DEV, (SR)	0.09		0.10	
ANALYST REL DEV, %	9.48		11.19	
HIGH YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	10	10	9	9
TRUE CONC (C) MG/L	2.61	2.05	2.61	2.05
MEAN RECOVERY (X)	4.87	2.06	2.56	2.21
ACCURACY(%REL ERROR)	86.54	0.37	-1.76	7.76
OVERALL STD DEV (S)	0.55	0.27	0.57	0.70
OVERALL REL STD DEV, %	11.35	12.94	22.23	31.91
SINGLE STD DEV, (SR)	0.26		0.46	
ANALYST REL DEV, %	7.43		19.17	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 2

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON IRON ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = 1.20614

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	-.1167	-.2480

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	64.65182	64.65182		
REG(WATER/DISTILLED)	2	1.14760	.57380	9.72	.0001
ERROR	92	5.43106	.05903		
TOTAL	95	71.23049			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERCEPT(WATER-DISTILLED) INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	SLOPE(WATER-DISTILLED) INTERVAL
2	-.1167	(-.2261 , -.0073)	-.2480	(-.3962 , -.0999)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR IRON ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 3	
AMPUL NO:	1	2	1	2
TRUE CONC:	30.40	25.00	30.40	25.00
LAB NUMBER				
1	48.70	42.20	60.00	30.00
2	205.00	233.00*	42.00	101.00
3	29.40	25.50	< 1.80*	101.00
4	12.50	11.50	190.00	150.00
5	66.00	27.80	134.00	24.00
6	26.90	27.80	545.00*	416.00*
7	73.00	73.00	86.00	86.00
8	< 3.00*	5.80*	31.00	11.00
9	180.00	12.50	10.80	10.20
10	35.50	35.50	70.00	25.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR IRON ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 3	
AMPUL NO:	3	4	3	4
TRUE CONC:	226.00	191.00	226.00	191.00
LAB NUMBER				
1	234.00	280.60	269.00	299.00
2	319.00	209.00	160.00	220.00
3	531.00	278.00	293.00	185.00
4	634.00	299.00	130.00	80.00
5	783.00	299.00	180.00	98.00
6	195.00	190.00	500.00*	360.00*
7	131.00	275.00	216.00	186.00
8	171.00*	159.00*	347.00	282.00
9	4112.00*	82.60*	320.00	208.50
10	280.00	261.00	255.00	235.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR IRON ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 3	
AMPUL NO:	5	6	5	6
TRUE CONC:	435.00	372.00	435.00	372.00
LAB NUMBER				
1	476.40	405.40	611.00	543.00
2	477.00	1027.00	930.00	871.00
3	415.00	509.00	1080.00	427.00
4	432.00	529.00	370.00	310.00
5	595.00	629.00	370.00	336.00
6	416.00	339.00	655.00*	540.00*
7	380.00	380.00	326.00	296.00
8	415.00*	387.00*	512.00	902.00
9	509.00	805.00	461.00	328.00
10	424.00	472.00	725.00	425.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR IRON ANALYSES BY WATER TYPE

	WATER 1		WATER 2	
LOW YOUDEN PAIR	1	2	1	2
NUMBER OF DATA POINTS	9	8	8	9
TRUE CONC (C) UG/L	30.40	25.00	30.40	25.00
MEAN RECOVERY (X)	75.22	31.97	77.97	59.80
ACCURACY(%REL ERROR)	147.44	27.90	156.50	139.20
OVERALL STD DEV (S)	69.43	19.55	58.74	50.55
OVERALL REL STD DEV, %	92.30	61.14	75.33	84.53
SINGLE STD DEV, (SR)	41.17		33.97	
ANALYST REL DEV, %	76.82		49.31	
MEDIUM YOUDEN PAIR	3	4	3	4
NUMBER OF DATA POINTS	8	8	9	9
TRUE CONC (C) UG/L	226.00	191.00	226.00	191.00
MEAN RECOVERY (X)	388.38	261.45	241.11	199.28
ACCURACY(%REL ERROR)	71.85	36.88	6.69	4.33
OVERALL STD DEV (S)	233.12	40.53	74.49	73.69
OVERALL REL STD DEV, %	60.03	15.50	30.89	36.98
SINGLE STD DEV, (SR)	150.48		41.53	
ANALYST REL DEV, %	46.31		18.86	
HIGH YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	9	9	9	9
TRUE CONC (C) UG/L	435.00	372.00	435.00	372.00
MEAN RECOVERY (X)	458.27	566.16	598.33	493.11
ACCURACY(%REL ERROR)	5.35	52.19	37.55	32.56
OVERALL STD DEV (S)	64.81	223.32	265.27	236.07
OVERALL REL STD DEV, %	14.14	39.45	44.34	47.87
SINGLE STD DEV, (SR)	140.99		193.70	
ANALYST REL DEV, %	27.52		35.49	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 3

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON IRON ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .95452

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.4885	-.1136

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	108.90628	108.90628		
REG(WATER/DISTILLED)	2	.54537	.27268	.77	.4668
ERROR	91	32.29562	.35490		
TOTAL	94	141.74727			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERCEPT(WATER-DISTILLED) INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	SLOPE(WATER-DISTILLED) INTERVAL
2	.4885	(-.6720 , 1.6490)	-.1136	(-.3430 , .1159)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGHIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR LEAD ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	1	2	1	2	1	2
TRUE CONC:	14.10	10.90	14.10	10.90	14.10	10.90
LAB NUMBER						
1	16.17	13.98	8.24*	6.05*	9.80	6.50
2	8.00	11.00	13.00	15.00	11.00	< 10.00*
3	11.50	8.30	14.30	8.60	14.20	8.30
4	29.00*	12.00	10.00	7.00	8.00	5.00
5	13.00	8.00	22.00	14.00	10.00	6.00
6	13.00	9.00	14.00	10.00	23.00*	30.00*
7	8.00*	7.00*	17.00	12.00	8.00*	6.00*
8	12.20	41.00*	12.60	< 2.00*	11.70	8.60
9	17.50	9.23	1.40	0.40	20.80	9.70
10	24.00*	18.00*	13.00	9.00	19.00	14.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR LEAD ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	3	4	3	4	3	4
TRUE CONC:	55.50	47.30	55.50	47.30	55.50	47.30
LAB NUMBER						
1	51.66	51.66	31.47*	28.44*	41.70	33.00
2	51.00	49.00	22.00	32.00	60.00	52.00
3	55.50	47.90	53.90	47.90	35.80	50.60
4	140.00*	100.00*	44.00	47.00	45.00	48.00
5	42.00	47.00	39.00	36.00	55.00	45.00
6	50.00	44.00	59.00	50.00	77.00*	71.00*
7	38.00*	37.00*	42.00	32.00	25.00*	24.00*
8	41.00	24.00	48.00	40.00	48.00	30.00
9	65.70	17.80	47.30	45.40	39.70	37.40
10	59.00*	79.00*	65.00	45.00	44.00	74.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR LEAD ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	5	6	5	6	5	6
TRUE CONC:	254.00	211.00	254.00	211.00	254.00	211.00
LAB NUMBER						
1	30.34	25.80*	156.40*	133.50*	181.00	153.00
2	269.00	222.00	190.00	168.00	262.00	225.00
3	233.00	190.00	227.00	183.00	226.00	153.00
4	250.00	200.00	220.00	170.00	220.00	180.00
5	154.00	214.00	110.00	74.00	173.00	238.00
6	192.00	159.00	279.00	217.00	231.00*	226.00*
7	178.00*	148.00*	202.00	162.00	200.00*	160.00*
8	225.00	169.00	214.00	170.00	219.00	197.00
9	166.00	121.00	248.00	196.00	219.00	177.00
10	359.00*	239.00*	275.00	265.00	234.00	264.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR LEAD ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3	
LOW YOUDEN PAIR	1	2	1	2	1	2
NUMBER OF DATA POINTS	7	7	9	8	8	7
TRUE CONC (C) UG/L	14.10	10.90	14.10	10.90	14.10	10.90
MEAN RECOVERY (X)	13.05	10.22	13.03	9.50	13.06	8.30
ACCURACY(%REL ERROR)	-7.43	-6.28	-7.57	-12.84	-7.36	-23.85
OVERALL STD DEV (S)	3.11	2.20	5.52	4.58	4.60	3.00
OVERALL REL STD DEV, %	23.85	21.52	42.32	48.26	35.22	36.13
SINGLE STD DEV, (SR)	2.63		2.15		2.03	
ANALYST REL DEV, %	22.58		19.06		19.01	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4
NUMBER OF DATA POINTS	7	7	9	9	8	8
TRUE CONC (C) UG/L	55.50	47.30	55.50	47.30	55.50	47.30
MEAN RECOVERY (X)	50.98	40.19	46.69	41.70	46.15	46.25
ACCURACY(%REL ERROR)	-8.14	-15.02	-15.88	-11.84	-16.85	-2.22
OVERALL STD DEV (S)	8.35	13.50	12.44	6.92	8.00	13.86
OVERALL REL STD DEV, %	16.39	33.58	26.65	16.60	17.34	29.97
SINGLE STD DEV, (SR)	12.56		6.01		11.01	
ANALYST REL DEV, %	27.54		13.61		23.83	
HIGH YOUDEN PAIR	5	6	5	6	5	6
NUMBER OF DATA POINTS	8	7	9	9	8	8
TRUE CONC (C) UG/L	254.00	211.00	254.00	211.00	254.00	211.00
MEAN RECOVERY (X)	189.92	182.14	218.33	178.33	216.75	198.38
ACCURACY(%REL ERROR)	-25.23	-13.68	-14.04	-15.48	-14.67	-5.98
OVERALL STD DEV (S)	75.86	35.19	50.84	50.91	28.39	40.53
OVERALL REL STD DEV, %	39.94	19.32	23.28	28.55	13.10	20.43
SINGLE STD DEV, (SR)	28.67		11.18		31.34	
ANALYST REL DEV, %	15.41		5.64		15.10	

WATER LEGEND

1 - LAB PURE WATER
2 - DRINKING WATER
3 - SURFACE WATER

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON LEAD ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .91930

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	-.6566	.1336
3	-.4235	.1111

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	205.69443	205.69443		
REG(WATER/DISTILLED)	4	1.18098	.29524	1.61	.1751
ERROR	128	23.44156	.18314		
TOTAL	133	230.31697			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	-.6566	(-1.4282 , .1151)	.1336	(-.0495 , .3168)
3	-.4235	(-1.2154 , .3684)	.1111	(-.0776 , .2998)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE ORTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR LEAD ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	1	2	1	2	1	2	1	2
TRUE CONC:	13.50	10.40	13.50	10.40	13.50	10.40	13.50	10.40
LAB NUMBER								
1	17.60*	12.60*	4.09*	0.34*	2.29*	1.47*	2.48	2.73
2	8.70	7.60 <	10.00* <	11.00*	14.00	8.00	1.00* <	10.00*
3	11.90	6.90	14.00	6.50	12.10	7.90	9.00	4.30
4	15.00	13.00	11.00	14.00	2.00	2.00	17.00*	9.00*
5	6.50	4.40	9.00	9.00	9.00	8.00	13.00	13.00
6	9.50	7.10	11.00	9.00	13.00	8.00	12.00	14.00
7	7.60*	5.50*	15.00	14.00	5.00*	4.00*	2.50*	1.50*
8	12.90	10.50	2.00* <	2.00*	10.60	7.00	8.20	5.10
9	11.90	8.40	13.70	12.60	4.30	2.70	11.40	8.20
10	15.00	13.00	13.00	13.00	16.00	7.00	24.00	10.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR LEAD ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	3	4	3	4	3	4	3	4
TRUE CONC:	53.00	45.20	53.00	45.20	53.00	45.20	53.00	45.20
LAB NUMBER								
1	78.00*	69.30*	21.15*	16.80*	18.30*	11.50*	18.09	14.67
2	56.70	79.60	19.00	44.00	37.00	33.00	27.00*	19.00*
3	52.70	45.10	46.80	43.60	103.00*	41.30	39.70	35.30
4	55.00	49.00	34.00	41.00	34.00	55.00	110.00*	160.00*
5	46.00	31.00	56.00	41.00	50.00	40.00	63.00	43.00
6	48.00	40.00	46.00	35.00	48.00	40.00	39.00	33.00
7	44.00*	36.00*	41.00	35.00	18.00*	21.00*	12.00*	11.00*
8	159.00*	149.00*	45.00	24.00	43.00	37.00	43.00	53.00
9	54.30	68.70	29.20	41.80	40.00	33.40	42.00	51.40
10	53.00	53.00	31.00	21.00	54.00	44.00	57.00	57.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR LEAD ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	5	6	5	6	5	6	5	6
TRUE CONC:	243.00	202.00	243.00	202.00	243.00	202.00	243.00	202.00
LAB NUMBER								
1	316.50*	254.40*	98.80*	98.00*	96.00*	73.00*	75.05	40.25
2	326.00	237.00	283.00	247.00	172.00	124.00	36.00*	10.00*
3	215.00	178.00	215.00	166.00	170.00	165.00	123.00	97.90
4	229.00	196.00	170.00	140.00	200.00	180.00	220.00*	130.00*
5	174.00	243.00	159.00	244.00	290.00	236.00	162.00	101.00
6	229.00	171.00	252.00	191.00	221.00	183.00	168.00	122.00
7	205.00*	140.00*	180.00	150.00	50.00*	41.00*	58.00*	48.00*
8	215.00	182.00	180.00	169.00	190.00	160.00	134.00	178.00
9	227.00	210.00	233.00	514.00*	93.80	87.20	166.00	235.00
10	271.00	271.00	251.00	171.00	264.00	164.00	167.00	87.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR LEAD ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	8	8	7	7	8	8	7	7
TRUE CONC (C) UG/L	13.50	10.40	13.50	10.40	13.50	10.40	13.50	10.40
MEAN RECOVERY (X)	11.42	8.86	12.31	11.16	10.12	6.32	11.44	8.19
ACCURACY(%REL ERROR)	-15.37	-14.78	-8.78	7.28	-25.00	-39.18	-15.26	-21.25
OVERALL STD DEV (S)	3.01	3.06	2.07	2.96	4.83	2:50	6.55	4.37
OVERALL REL STD DEV, %	26.38	34.54	16.82	26.55	47.68	39.48	57.24	53.38
SINGLE STD DEV, (SR)	0.84		2.26		2.08		3.74	
ANALYST REL DEV, %	8.27		19.25		25.30		38.13	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	7	7	9	9	7	8	7	7
TRUE CONC (C) UG/L	53.00	45.20	53.00	45.20	53.00	45.20	53.00	45.20
MEAN RECOVERY (X)	52.24	52.34	38.67	36.27	43.71	40.46	43.11	41.05
ACCURACY(%REL ERROR)	-1.43	15.80	-27.04	-19.76	-17.52	-10.48	-18.65	-9.18
OVERALL STD DEV (S)	3.86	16.75	11.31	8.48	7.27	7.00	14.40	14.73
OVERALL REL STD DEV, %	7.39	31.99	29.24	23.39	16.64	17.29	33.40	35.88
SINGLE STD DEV, (SR)	9.64		10.35		7.75		7.22	
ANALYST REL DEV, %	18.43		27.63		18.42		17.16	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	8	8	9	8	8	8	7	7
TRUE CONC (C) UG/L	243.00	202.00	243.00	202.00	243.00	202.00	243.00	202.00
MEAN RECOVERY (X)	235.75	211.00	213.67	184.75	200.10	162.40	142.15	123.02
ACCURACY(%REL ERROR)	-2.98	4.46	-12.07	-8.54	-17.65	-19.60	-41.50	-39.10
OVERALL STD DEV (S)	45.09	35.97	43.60	40.40	60.59	43.58	34.60	64.33
OVERALL REL STD DEV, %	19.12	17.05	20.41	21.87	30.28	26.84	24.34	52.29
SINGLE STD DEV, (SR)	32.71		35.20		21.81		38.96	
ANALYST REL DEV, %	14.64		17.67		12.04		29.38	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 1
3 - EFFLUENT 2
4 - EFFLUENT 3

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON LEAD ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = 1.06568

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.2694	-.0961
3	-.3729	.0302
4	.3997	-.1468

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	273.95189	273.95189		
REG(WATER/DISTILLED)	6	2.90558	.48426	4.55	.0003
ERROR	167	17.78549	.10650		
TOTAL	174	294.64296			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	.2694	(-.3481 , .8868)	-.0961	(-.2443 , .0522)
3	-.3729	(-.9748 , .2289)	.0302	(-.1163 , .1768)
4	.3997	(-.2269 , 1.0264)	-.1468	(-.2985 , .0048)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

I M V S BREAK: WATER(S) REJECTED DUE TO INSUFFICIENT OR BAD AMPUL DATA - NO MULTIPLICATIVE MODEL ANALYSIS WILL BE PRINTED.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR MANGANESE ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	1	2	1	2	1	2
TRUE CONC:	0.60	0.44	0.60	0.44	0.60	0.44
LAB NUMBER						
1	0.26	0.68	2.30	1.60 -	4.80* -	33.00*
2	< 2.00* <	2.00*	1.00* <	2.00* <	2.00* <	2.00*
3	3.70	1.70 <	0.50* <	0.50*	8.00 <	0.50*
4	5.10	2.30 -	1.70* -	1.70* -	2.00* -	2.00*
5	< 0.10* <	0.10*	3.00	1.00 <	1.00*	10.00*
6	4.00	3.00	3.00	4.00	15.00*	14.00*
7	< 1.00* <	1.00*	13.00*	1.00	7.00 -	2.00*
8	< 2.00* <	2.00* <	2.00* <	2.00*	4.00 <	2.00*
9	0.60 <	0.60*	0.40	0.40 -	2.00* -	0.30*
10	1.40	0.60	2.00	2.00 <	1.00*	5.00*

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR MANGANESE ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	3	4	3	4	3	4
TRUE CONC:	5.00	7.95	5.00	7.95	5.00	7.95
LAB NUMBER						
1	4.04	5.94	2.80	5.80 -	54.60* -	43.80*
2	158.00*	182.00* <	2.00* <	2.00* <	2.00*	131.00*
3	4.50	7.20	3.30	6.10 <	0.50* <	0.50*
4	5.30	6.80	3.30	7.10	10.00	16.00
5	3.00	8.00 <	1.00*	16.00	6.00	12.00
6	10.00	15.00	9.00	7.00	16.00*	20.00*
7	11.00	8.00	5.00	14.00 -	10.00*	3.00
8	10.00	20.00 <	2.00* <	2.00*	10.00	9.00
9	4.80	16.30	2.40	5.90	3.40	5.90
10	5.20	8.80	7.00	7.00 -	5.00*	5.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR MANGANESE ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	5	6	5	6	5	6
TRUE CONC:	14.80	11.80	14.80	11.80	14.80	11.80
LAB NUMBER						
1	14.36	10.14	11.90	9.70	- 18.00*	7.00
2	2.60	6.50	< 2.00*	< 2.00*	< 2.00*	< 2.00*
3	12.70	9.80	11.20	8.90	6.00	< 0.50*
4	13.00	10.00	11.00	9.10	20.00	17.00
5	18.00	12.00	26.00	24.00	20.00	16.00
6	26.00	21.00	18.00	17.00	30.00*	24.00*
7	15.00	12.00	18.00	11.00	14.00 -	7.00*
8	4.00	8.00	6.00*	6.00*	19.00	17.00
9	334.00*	236.00*	11.10	8.50	8.40	8.50
10	10.00	15.00	17.00	47.00*	10.00 <	1.00*

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR MANGANESE ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3	
LOW YOUDEN PAIR	1	2	1	2	1	2
NUMBER OF DATA POINTS	6	5	5	6	3	0
TRUE CONC (C) UG/L	0.60	0.44	0.60	0.44	0.60	0.44
MEAN RECOVERY (X)	2.51	1.66	2.14	1.67	6.33	UND
ACCURACY(%REL ERROR)	321.14	275.51	259.06	277.93	962.64	UND
OVERALL STD DEV (S)	2.01	1.04	1.07	1.27	2.08	UND
OVERALL REL STD DEV, %	80.25	62.54	49.85	76.15	32.87	UND
SINGLE STD DEV, (SR)	0.87		0.78		UND	
ANALYST REL DEV, %	41.64		41.17		UND	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4
NUMBER OF DATA POINTS	9	9	7	8	4	6
TRUE CONC (C) UG/L	5.00	7.95	5.00	7.95	5.00	7.95
MEAN RECOVERY (X)	6.43	10.67	4.69	8.61	7.35	8.48
ACCURACY(%REL ERROR)	28.53	34.23	-6.29	8.33	47.00	6.71
OVERALL STD DEV (S)	3.02	5.06	2.47	4.01	3.24	4.86
OVERALL REL STD DEV, %	47.01	47.40	52.77	46.58	44.07	57.27
SINGLE STD DEV, (SR)	3.11		2.43		2.37	
ANALYST REL DEV, %	36.43		36.53		29.93	
HIGH YOUDEN PAIR	5	6	5	6	5	6
NUMBER OF DATA POINTS	9	9	8	7	7	5
TRUE CONC (C) UG/L	14.80	11.80	14.80	11.80	14.80	11.80
MEAN RECOVERY (X)	12.85	11.60	15.52	12.60	13.91	13.10
ACCURACY(%REL ERROR)	-13.17	-1.66	4.90	6.78	-5.98	11.02
OVERALL STD DEV (S)	7.05	4.29	5.29	5.82	5.89	4.93
OVERALL REL STD DEV, %	54.88	36.96	34.09	46.17	42.35	37.63
SINGLE STD DEV, (SR)	3.04		1.38		1.24	
ANALYST REL DEV, %	24.83		9.83		9.17	

WATER LEGEND

1 - LAB PURE WATER
2 - DRINKING WATER
3 - SURFACE WATER

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR MANGANESE ANALYSES BY WATER TYPE

	WATER 1		WATER 2	
LOW YOUDEN PAIR	1	2	1	2
NUMBER OF DATA POINTS	8	8	9	9
TRUE CONC (C) UG/L	91.00	107.00	91.00	107.00
MEAN RECOVERY (X)	214.50	109.38	80.82	98.10
ACCURACY(%REL ERROR)	135.71	2.22	-11.18	-8.32
OVERALL STD DEV (S)	22.16	18.56	38.55	47.18
OVERALL REL STD DEV, %	10.33	16.97	47.70	48.10
SINGLE STD DEV, (SR)	16.23		45.46	
ANALYST REL DEV, %	10.02		50.82	
MEDIUM YOUDEN PAIR	3	4	3	4
NUMBER OF DATA POINTS	8	8	9	9
TRUE CONC (C) UG/L	192.00	220.00	192.00	220.00
MEAN RECOVERY (X)	181.50	207.75	189.22	187.44
ACCURACY(%REL ERROR)	-5.47	-5.57	-1.45	-14.80
OVERALL STD DEV (S)	14.72	23.53	37.73	70.55
OVERALL REL STD DEV, %	8.11	11.33	19.94	37.64
SINGLE STD DEV, (SR)	16.43		41.00	
ANALYST REL DEV, %	8.44		21.77	
HIGH YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	7	8	9	9
TRUE CONC (C) UG/L	484.00	420.00	484.00	420.00
MEAN RECOVERY (X)	442.57	422.50	470.11	402.00
ACCURACY(%REL ERROR)	-8.56	0.60	-2.87	-4.29
OVERALL STD DEV (S)	23.72	51.21	84.88	73.70
OVERALL REL STD DEV, %	5.36	12.12	18.06	18.33
SINGLE STD DEV, (SR)	23.93		71.25	
ANALYST REL DEV, %	5.53		16.34	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 1

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR MANGANESE ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1	
AMPUL NO:	1	2	1	2
TRUE CONC:	91.00	107.00	91.00	107.00
LAB NUMBER				
1	207.00	109.00	120.50	134.00
2	189.00	104.00	78.00	65.00
3	192.00	95.00	62.90	71.90
4	211.00	108.00	90.00	80.00
5	244.00	84.00	< 1.00*	< 1.00*
6	221.00*	111.00*	79.00	130.00
7	235.00	138.00	140.00	130.00
8	198.00	102.00	76.00	96.00
9	145.00*	83.00*	1.00	166.00
10	240.00	135.00	80.00	10.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR MANGANESE ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1	
AMPUL NO:	3	4	3	4
TRUE CONC:	192.00	220.00	192.00	220.00
LAB NUMBER				
1	175.00	213.00	218.00	250.00
2	152.00	186.00	128.00	147.00
3	188.00	207.00	152.00	166.00
4	189.00	226.00	220.00	180.00
5	179.00	164.00	< 1.00*	< 1.00*
6	227.00*	289.00*	180.00	180.00
7	203.00	204.00	254.00	308.00
8	187.00	227.00	179.00	169.00
9	134.00*	146.00*	192.00	57.00
10	179.00	235.00	180.00	230.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR MANGANESE ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1	
AMPUL NO:	5	6	5	6
TRUE CONC:	484.00	420.00	484.00	420.00
LAB NUMBER				
1	470.00	455.00	592.00	442.00
2	436.00	465.00	426.00	373.00
3	406.00	346.00	600.00	383.00
4	460.00	405.00	520.00	340.00
5	439.00	376.00	56.00*	49.00*
6	699.00*	593.00*	447.00	479.00
7	465.00	418.00	447.00	408.00
8	422.00	409.00	430.00	379.00
9	336.00*	1.50*	339.00	284.00
10	598.00*	506.00	430.00	530.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON MANGANESE ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .65345

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	-3.3268	.5813

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	36.32748	36.32748		
REG(WATER/DISTILLED)	2	4.35484	2.17742	7.60	.0009
ERROR	88	25.22618	.28666		
TOTAL	91	65.90850			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERCEPT(WATER-DISTILLED) INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	SLOPE(WATER-DISTILLED) INTERVAL
2	-3.3268	(-5.3970 , -1.2567)	.5813	(.1961 , .9664)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR MANGANESE ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 2	
AMPUL NO:	1	2	1	2
TRUE CONC:	151.00	111.00	151.00	111.00
LAB NUMBER				
1	147.00	113.00	126.00	91.00
2	134.00	108.00	84.00	92.00
3	136.00	99.00	125.00	83.00
4	150.00	112.00	90.00	130.00
5	173.00	87.00	74.00	189.00*
6	156.00*	115.00*	70.00*	80.00*
7	167.00	143.00	103.00	89.00
8	140.00	105.00	120.00	87.00
9	103.00*	86.00*	80.50	66.50
10	170.00	140.00	50.00	100.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR MANGANESE ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 2	
AMPUL NO:	3	4	3	4
TRUE CONC:	227.00	302.00	227.00	302.00
LAB NUMBER				
1	206.00	291.00	142.00	183.00
2	179.00	253.00	176.00	204.00
3	221.00	282.00	151.00	233.00
4	222.00	307.00	160.00	190.00
5	211.00	223.00	537.00*	5.00
6	267.00*	393.00*	63.00*	152.00*
7	239.00	277.00	183.00	247.00
8	220.00	308.00	169.00	97.00
9	158.00*	198.00*	149.00	87.50
10	210.00	320.00	150.00	350.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR MANGANESE ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 2	
AMPUL NO:	5	6	5	6
TRUE CONC:	666.00	577.00	666.00	577.00
LAB NUMBER				
1	643.00	633.00	650.00	570.00
2	597.00	646.00	548.00	537.00
3	556.00	481.00	560.00	503.00
4	630.00	563.00	540.00	460.00
5	602.00	523.00	191.00	613.00
6	958.00*	826.00*	367.00*	293.00*
7	636.00	581.00	606.00	526.00
8	578.00	569.00	572.00	546.00
9	460.00*	2.10*	312.00	399.00
10	819.00*	704.00	1000.00	950.00*

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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR MANGANESE ANALYSES BY WATER TYPE

	WATER 1		WATER 2	
LOW YOUDEN PAIR	1	2	1	2
NUMBER OF DATA POINTS	8	8	9	8
TRUE CONC (C) UG/L	151.00	111.00	151.00	111.00
MEAN RECOVERY (X)	152.13	113.38	94.72	92.31
ACCURACY(%REL ERROR)	0.75	2.14	-37.27	-16.84
OVERALL STD DEV (S)	15.78	19.23	25.91	18.02
OVERALL REL STD DEV, %	10.37	16.97	27.36	19.52
SINGLE STD DEV, (SR)	13.96		24.54	
ANALYST REL DEV, %	10.52		26.25	
MEDIUM YOUDEN PAIR	3	4	3	4
NUMBER OF DATA POINTS	8	8	8	9
TRUE CONC (C) UG/L	227.00	302.00	227.00	302.00
MEAN RECOVERY (X)	213.50	282.63	160.00	177.39
ACCURACY(%REL ERROR)	-5.95	-6.42	-29.52	-41.26
OVERALL STD DEV (S)	17.26	32.00	14.60	101.79
OVERALL REL STD DEV, %	8.09	11.32	9.12	57.38
SINGLE STD DEV, (SR)	22.12		60.37	
ANALYST REL DEV, %	8.92		35.79	
HIGH YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	7	8	9	8
TRUE CONC (C) UG/L	666.00	577.00	666.00	577.00
MEAN RECOVERY (X)	606.00	587.50	553.22	519.25
ACCURACY(%REL ERROR)	-9.01	1.82	-16.93	-10.01
OVERALL STD DEV (S)	32.21	71.27	224.10	66.20
OVERALL REL STD DEV, %	5.32	12.13	40.51	12.75
SINGLE STD DEV, (SR)	33.31		121.03	
ANALYST REL DEV, %	5.58		22.57	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 2

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON MANGANESE ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .97778

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	-1.0018	.1148

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	43.54711	43.54711		
REG(WATER/DISTILLED)	2	3.05148	1.52574	7.99	.0007
ERROR	86	16.43024	.19105		
TOTAL	89	63.02882			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	-1.0018	(-2.7291 , .7255)	.1148	(-.1906 , .4202)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR MANGANESE ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 3	
AMPUL NO:	1	2	1	2
TRUE CONC:	0.57	0.42	0.57	0.42
LAB NUMBER				
1	0.25	0.65 -	0.98* -	0.98*
2	< 2.00* <	2.00* <	2.00* <	2.00*
3	3.60	1.60 <	0.50*	0.90
4	4.90	2.20	1.70	0.80
5	< 1.00* <	1.00* <	1.00* <	1.00*
6	3.80	2.90	12.00*	10.00*
7	< 1.00* <	1.00* <	1.00*	9.00
8	< 2.00* <	2.00* <	2.00* <	2.00*
9	0.58 <	0.60*	1.70 -	1.10*
10	1.30	0.58	1.60	2.80

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR MANGANESE ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 3	
AMPUL NO:	3	4	3	4
TRUE CONC:	4.78	7.61	4.78	7.61
LAB NUMBER				
1	3.88	5.70	2.61	5.12
2	152.00*	172.00*	10.00	5.00
3	4.30	6.90	4.10	5.80
4	5.10	6.50	5.20	7.70
5	2.90	7.70	6.00	8.00
6	9.60	14.40	21.00*	17.00*
7	10.60	7.70	5.00	7.00
8	9.60	19.20 <	2.00* <	2.00*
9	4.60	15.70 -	1.50*	4.10
10	5.00	8.50	3.80	8.80

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR MANGANESE ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 3	
AMPUL NO:	5	6	5	6
TRUE CONC:	14.20	11.30	14.20	11.30
LAB NUMBER				
1	13.80	9.73	10.31	8.05
2	2.50	6.24	9.00	6.00
3	12.20	9.40	10.40	8.80
4	12.50	9.60	14.00	11.00
5	17.30	11.50	19.00	13.00
6	25.00	20.00	29.00*	24.00*
7	14.40	11.50	9.00	6.00
8	3.80	7.70	14.00	12.00
9	321.00*	227.00*	7.60	10.90
10	9.60	14.40	18.80	8.80

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR MANGANESE ANALYSES BY WATER TYPE

	WATER 1		WATER 2	
LOW YOUDEN PAIR	1	2	1	2
NUMBER OF DATA POINTS	6	5	3	4
TRUE CONC (C) UG/L	0.57	0.42	0.57	0.42
MEAN RECOVERY (X)	2.40	1.59	1.67	3.37
ACCURACY(%REL ERROR)	321.93	275.83	192.40	699.76
OVERALL STD DEV (S)	1.94	1.00	0.06	3.86
OVERALL REL STD DEV, %	80.62	62.99	3.46	114.41
SINGLE STD DEV, (SR)	0.85		1.05	
ANALYST REL DEV, %	42.56		41.65	
MEDIUM YOUDEN PAIR	3	4	3	4
NUMBER OF DATA POINTS	9	9	7	8
TRUE CONC (C) UG/L	4.78	7.61	4.78	7.61
MEAN RECOVERY (X)	6.18	10.26	5.24	6.44
ACCURACY(%REL ERROR)	29.20	34.76	9.71	-15.37
OVERALL STD DEV (S)	2.91	4.86	2.37	1.67
OVERALL REL STD DEV, %	47.06	47.40	45.11	25.99
SINGLE STD DEV, (SR)	3.00		2.18	
ANALYST REL DEV, %	36.56		37.32	
HIGH YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	9	9	9	9
TRUE CONC (C) UG/L	14.20	11.30	14.20	11.30
MEAN RECOVERY (X)	12.34	11.12	12.46	9.39
ACCURACY(%REL ERROR)	-13.07	-1.60	-12.28	-16.86
OVERALL STD DEV (S)	6.79	4.07	4.24	2.50
OVERALL REL STD DEV, %	54.98	36.62	34.08	26.66
SINGLE STD DEV, (SR)	2.94		2.51	
ANALYST REL DEV, %	25.09		23.01	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 3

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON MANGANESE ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .62440

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.1957	-.0842

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	40.98493	40.98493		
REG(WATER/DISTILLED)	2	.28611	.14305	.56	.5760
ERROR	74	19.04432	.25736		
TOTAL	77	60.31535			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	.1957	(-.2251 , .6165)	-.0842	(-.2879 , .1195)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR NICKEL ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	1	2	1	2	1	2
TRUE CONC:	27.40	31.10	27.40	31.10	27.40	31.10
LAB NUMBER						
1	35.50	39.90	37.70*	39.70*	30.00	32.80
2	16.00	17.00	19.00	< 10.00*	19.00	18.00
3	19.00	25.00	10.90	12.80	50.40	94.20*
4	17.00	25.00	23.00	51.00	19.00	22.00
5	32.00	32.00	< 10.00*	26.00*	45.00	22.00
6	11.00	21.00	25.00	28.00	36.00	46.00
7	26.00	33.00	27.00	28.00	24.00	28.00
8	23.00	26.00	25.00	35.00	4.00	2.00
9	16.20	25.20	16.20	18.00	19.30	24.10
10	28.00	42.00	35.00*	35.00*	28.00*	42.00*

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR NICKEL ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	3	4	3	4	3	4
TRUE CONC:	200.00	240.00	200.00	240.00	200.00	240.00
LAB NUMBER						
1	175.00	229.00	201.00*	260.00*	175.00	229.00
2	150.00	217.00	82.00	94.00	214.00	238.00
3	163.00	208.00	164.00	187.00	180.00	186.00
4	190.00	240.00	180.00	270.00	180.00	220.00
5	157.00	129.00	34.00*	31.00*	64.00	124.00
6	212.00	188.00	211.00	264.00	221.00	199.00
7	167.00	199.00	153.00	159.00	136.00	166.00
8	164.00	174.00	79.00	110.00	152.00	127.00
9	143.00	181.00	159.00	175.00	131.50	172.00
10	280.00*	280.00	250.00*	250.00*	260.00*	320.00*

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR NICKEL ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	5	6	5	6	5	6
TRUE CONC:	402.00	482.00	402.00	482.00	402.00	482.00
LAB NUMBER						
1	362.00	498.00	511.00*	560.00*	352.00	414.00
2	533.00	392.00	272.00	330.00	295.00	353.00
3	276.00	290.00	407.00	464.00	480.00	585.00*
4	370.00	500.00	410.00	540.00	360.00	400.00
5	454.00	528.00	49.00*	73.00*	406.00	396.00
6	457.00	516.00	419.00	385.00	356.00	420.00
7	383.00	439.00	344.00	392.00	392.00	416.00
8	500.00	810.00	300.00	470.00	272.00	472.00
9	225.00	268.00	340.00	287.00	272.00	348.00
10	600.00	300.00	750.00*	750.00*	450.00*	700.00*

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR NICKEL ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3	
LOW YOUDEN PAIR	1	2	1	2	1	2
NUMBER OF DATA POINTS	10	10	7	6	9	8
TRUE CONC (C) UG/L	27.40	31.10	27.40	31.10	27.40	31.10
MEAN RECOVERY (X)	22.37	28.61	20.87	28.80	27.41	24.36
ACCURACY(%REL ERROR)	-18.36	-8.01	-23.83	-7.40	0.04	-21.66
OVERALL STD DEV (S)	7.88	7.99	5.79	13.46	14.51	12.56
OVERALL REL STD DEV, %	35.22	27.93	27.73	46.72	52.95	51.56
SINGLE STD DEV, (SR)	3.04		7.43		7.02	
ANALYST REL DEV, %	11.91		29.94		27.11	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4
NUMBER OF DATA POINTS	9	10	7	7	9	9
TRUE CONC (C) UG/L	200.00	240.00	200.00	240.00	200.00	240.00
MEAN RECOVERY (X)	169.00	204.50	146.86	179.86	161.50	184.56
ACCURACY(%REL ERROR)	-15.50	-14.79	-26.57	-25.06	-19.25	-23.10
OVERALL STD DEV (S)	21.13	41.12	49.16	68.27	47.84	41.50
OVERALL REL STD DEV, %	12.50	20.11	33.48	37.96	29.62	22.49
SINGLE STD DEV, (SR)	24.03		20.84		21.78	
ANALYST REL DEV, %	12.87		12.76		12.59	
HIGH YOUDEN PAIR	5	6	5	6	5	6
NUMBER OF DATA POINTS	10	10	7	7	9	8
TRUE CONC (C) UG/L	402.00	482.00	402.00	482.00	402.00	482.00
MEAN RECOVERY (X)	416.00	454.10	356.00	409.71	353.89	402.38
ACCURACY(%REL ERROR)	3.48	-5.79	-11.44	-15.00	-11.97	-16.52
OVERALL STD DEV (S)	115.44	159.65	57.85	87.46	68.00	39.50
OVERALL REL STD DEV, %	27.75	35.16	16.25	21.35	19.22	9.82
SINGLE STD DEV, (SR)	115.71		56.63		43.37	
ANALYST REL DEV, %	26.60		14.79		11.47	

WATER LEGEND

1 - LAB PURE WATER
2 - DRINKING WATER
3 - SURFACE WATER

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON NICKEL ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = 1.03994

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.0459	-.0225
3	-.1410	.0092

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	216.29453	216.29453		
REG(WATER/DISTILLED)	4	.28247	.07062	.51	.7287
ERROR	137	18.98417	.13857		
TOTAL	142	235.56118			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	.0459	(-.7964 , .8882)	-.0225	(-.1871 , .1421)
3	-.1410	(-.9232 , .6412)	.0092	(-.1444 , .1628)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR NICKEL ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	1	2	1	2	1	2	1	2
TRUE CONC:	26.20	29.70	26.20	29.70	26.20	29.70	26.20	29.70
LAB NUMBER								
1	60.50*	60.60*	27.60	46.50	34.20	45.10	2.00	8.00
2	21.80	32.60	17.30	40.00	21.00	14.00 <	10.00* <	10.00*
3	26.10	23.90	28.00	30.00	16.00	16.00 <	4.00* <	4.00*
4	18.50	22.80	34.00*	69.00*	24.00	22.00	17.00	25.00
5	16.30	23.90	39.00	40.00	24.00	25.00	28.00	32.00
6	45.70	30.40	61.00*	72.00*	7.00* <	2.00*	3.00	3.00
7	23.90	27.20	17.00	30.00	15.00	20.00	4.00	124.00*
8	26.10	29.40	9.00 <	5.00*	5.00	3.00 <	5.00* <	5.00*
9	40.30	48.20	1.40*	11.00*	13.10	16.70	7.20 -	13.40*
10	39.10	41.30	27.00	32.00	20.00	8.00	70.00*	60.00*

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR NICKEL ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	3	4	3	4	3	4	3	4
TRUE CONC:	191.00	230.00	191.00	230.00	191.00	230.00	191.00	230.00
LAB NUMBER								
1	240.00*	309.00*	398.00*	514.00*	179.00	235.00	294.00	388.00*
2	126.00	145.00	179.00	174.00	116.00	244.00	184.00	212.00
3	163.00	204.00	201.00	202.00	168.00	179.00	104.00	155.00
4	174.00	218.00	230.00*	210.00*	190.00	220.00	160.00	200.00
5	207.00	96.00	132.00	121.00	120.00	156.00	< 10.00*	< 10.00*
6	148.00	176.00	214.00*	304.00*	162.00*	39.00*	148.00	162.00
7	165.00	187.00	160.00	173.00	143.00	166.00	149.00	199.00
8	146.00	163.00	80.00	160.00	120.00	140.00	174.00	213.00
9	103.00	145.00	72.70*	148.00*	109.00	122.00	86.80	147.00
10	261.00	283.00	172.00	192.00	190.00	140.00	220.00*	340.00*

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR NICKEL ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	5	6	5	6	5	6	5	6
TRUE CONC:	385.00	461.00	385.00	461.00	385.00	461.00	385.00	461.00
LAB NUMBER								
1	547.00*	624.00*	188.00	252.00	398.00	471.00	282.00	331.00
2	346.00	313.00	260.00	301.00	416.00	473.00	295.00	358.00
3	238.00	339.00	229.00	287.00	406.00	401.00	329.00	418.00
4	413.00	446.00	380.00*	460.00*	370.00	440.00	370.00	420.00
5	314.00	466.00	244.00	361.00	228.00	282.00	< 10.00*	< 10.00*
6	297.00	350.00	358.00*	405.00*	162.00*	207.00*	251.00	316.00
7	371.00	419.00	390.00*	440.00	384.00	408.00	324.00	373.00
8	424.00	620.00	250.00	260.00	240.00	360.00	99.00*	113.00*
9	200.00	309.00	180.00*	242.00*	246.00	249.00	245.00	291.00
10	489.00	435.00	242.00	272.00	640.00	790.00*	390.00*	640.00*

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR NICKEL ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	9	9	7	6	9	9	6	4
TRUE CONC (C) UG/L	26.20	29.70	26.20	29.70	26.20	29.70	26.20	29.70
MEAN RECOVERY (X)	28.64	31.08	23.56	36.42	19.14	18.87	10.20	17.00
ACCURACY(%REL ERROR)	9.33	4.64	-10.09	22.62	-26.93	-36.48	-61.07	-42.76
OVERALL STD DEV (S)	10.45	8.59	9.84	6.77	8.23	11.95	10.29	13.74
OVERALL REL STD DEV, %	36.48	27.63	41.75	18.59	42.98	63.36	100.90	80.80
SINGLE STD DEV, (SR)	5.41		6.47		4.73		2.42	
ANALYST REL DEV, %	18.10		21.57		24.89		17.76	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	9	9	6	6	9	9	8	7
TRUE CONC (C) UG/L	191.00	230.00	191.00	230.00	191.00	230.00	191.00	230.00
MEAN RECOVERY (X)	165.89	179.67	154.00	170.33	148.33	178.00	162.47	184.00
ACCURACY(%REL ERROR)	-13.15	-21.88	-19.37	-25.94	-22.34	-22.61	-14.93	-20.00
OVERALL STD DEV (S)	46.20	53.02	42.79	28.40	33.59	44.75	62.61	28.28
OVERALL REL STD DEV, %	27.85	29.51	27.78	16.67	22.64	25.14	38.53	15.37
SINGLE STD DEV, (SR)	33.91		23.48		33.09		10.99	
ANALYST REL DEV, %	19.62		14.48		20.28		6.34	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	9	9	6	7	9	8	7	7
TRUE CONC (C) UG/L	385.00	461.00	385.00	461.00	385.00	461.00	385.00	461.00
MEAN RECOVERY (X)	343.56	410.78	235.50	310.43	369.78	385.50	299.43	358.14
ACCURACY(%REL ERROR)	-10.76	-10.89	-38.83	-32.66	-3.95	-16.38	-22.23	-22.31
OVERALL STD DEV (S)	92.19	98.41	25.39	67.60	127.34	83.39	44.89	49.41
OVERALL REL STD DEV, %	26.84	23.96	10.78	21.78	34.44	21.63	14.99	13.80
SINGLE STD DEV, (SR)	57.63		26.01		29.03		10.81	
ANALYST REL DEV, %	15.28		9.53		7.69		3.29	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 1
3 - EFFLUENT 2
4 - EFFLUENT 3

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON NICKEL ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .92332

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.1356	-.0644
3	-1.3151	.2194
4	-2.6897	.4596

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	265.20028	265.20028		
REG(WATER/DISTILLED)	6	11.83860	1.97310	13.35	.0000
ERROR	167	24.67543	.14776		
TOTAL	174	301.71431			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	.1356	(-.7977 , 1.0689)	-.0644	(-.2492 , .1204)
3	-1.3151	(-2.1719 , -.4584)	.2194	(.0492 , .3896)
4	-2.6897	(-3.6894 , -1.6901)	.4596	(.2653 , .6540)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR SELENIUM ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	1	2	1	2	1	2
TRUE CONC:	12.10	10.50	12.10	10.50	12.10	10.50
LAB NUMBER						
1	13.31	11.32	4.60	1.40	8.70	7.20
2	11.00	9.00 <	8.00* <	8.00* <	8.00*	5.00*
3	13.90*	13.20*	16.80	14.90	17.30*	12.60*
4	12.00	12.00	13.00	9.00	13.00	10.00
5	1.00*	1.00	9.00	6.00	13.00	9.00
6	11.00	13.00	21.00	17.00	17.00	15.00
7	13.00	12.00	14.00	11.00	6.00	6.00
8	14.00	13.00	18.00	10.00	17.00	11.00
9	17.80	20.40	25.20	10.10	6.30	8.00
10	15.00	10.00	15.00	10.00	15.00	10.00

ENVIRONMENTAL MONITORING AND SUPPORT LAROATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR SELENIUM ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	3	4	3	4	3	4
TRUE CONC:	76.40	96.80	76.40	96.80	76.40	96.80
LAB NUMBER						
1	73.20	113.94	54.40	70.00	64.80	80.20
2	83.00	98.00	36.00*	43.00*	44.00*	50.00*
3	89.90*	126.00*	93.80	115.00	113.00*	131.00*
4	83.00	110.00	94.00	130.00	96.00	120.00
5	83.00	88.00	75.00	98.00	75.00	52.00
6	89.00	109.00	91.00	115.00	84.00	110.00
7	65.00	75.00	71.00	87.00	57.00	67.00
8	71.00	100.00	88.00	110.00	78.00	65.00
9	67.90	79.40	56.70	73.60	69.10	96.90
10	80.00	110.00	90.00	110.00	80.00	100.00

ENVIRONMENTAL MONITORING AND SUPPORT LARORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR SELENIUM ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	5	6	5	6	5	6
TRUE CONC:	205.00	246.00	205.00	246.00	205.00	246.00
LAB NUMBER						
1	237.50	278.00	258.00	324.00	254.00	292.00
2	204.00	254.00	140.00*	162.00*	148.00*	167.00*
3	272.00*	322.00*	272.00	313.00	292.00*	334.00*
4	260.00	230.00	190.00	280.00	190.00	220.00
5	184.00	44.00*	171.00	195.00	234.00	225.00
6	204.00	250.00	245.00	288.00	224.00	327.00
7	140.00	150.00	226.00	246.00	202.00	212.00
8	174.00	256.00	180.00	211.00	174.00	255.00
9	156.00	196.00	205.00	273.00	232.00	234.00
10	230.00	270.00	220.00	320.00	200.00	300.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR SELENIUM ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3	
LOW YOUDEN PAIR	1	2	1	2	1	2
NUMBER OF DATA POINTS	8	9	9	9	8	8
TRUE CONC (C) UG/L	12.10	10.50	12.10	10.50	12.10	10.50
MEAN RECOVERY (X)	13.39	11.30	15.18	9.93	12.00	9.52
ACCURACY(%REL ERROR)	10.65	7.64	25.44	-5.40	-0.83	-9.29
OVERALL STD DEV (S)	2.27	5.03	6.14	4.54	4.48	2.75
OVERALL REL STD DEV, %	16.92	44.53	40.42	45.71	37.32	28.90
SINGLE STD DEV, (SR)	1.70		2.89		1.82	
ANALYST REL DEV, %	13.80		22.99		16.87	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4
NUMBER OF DATA POINTS	9	9	9	9	8	8
TRUE CONC (C) UG/L	76.40	96.80	76.40	96.80	76.40	96.80
MEAN RECOVERY (X)	77.23	98.15	79.32	100.96	75.49	86.39
ACCURACY(%REL ERROR)	1.09	1.39	3.82	4.29	-1.19	-10.76
OVERALL STD DEV (S)	8.20	14.33	15.70	20.35	12.05	24.02
OVERALL REL STD DEV, %	10.62	14.60	19.79	20.15	15.97	27.80
SINGLE STD DEV, (SR)	8.20		4.38		13.39	
ANALYST REL DEV, %	9.35		4.86		16.54	
HIGH YOUDEN PAIR	5	6	5	6	5	6
NUMBER OF DATA POINTS	9	8	9	9	8	8
TRUE CONC (C) UG/L	205.00	246.00	205.00	246.00	205.00	246.00
MEAN RECOVERY (X)	198.83	235.50	218.56	272.22	213.75	258.13
ACCURACY(%REL ERROR)	-3.01	-4.27	6.61	10.66	4.27	4.93
OVERALL STD DEV (S)	39.36	42.88	35.21	46.55	26.56	42.95
OVERALL REL STD DEV, %	19.80	18.21	16.11	17.10	12.43	16.64
SINGLE STD DEV, (SR)	23.12		20.35		31.56	
ANALYST REL DEV, %	10.65		8.29		13.38	

WATER LEGEND

1 - LAB PURE WATER
2 - DRINKING WATER
3 - SURFACE WATER

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON SELENIUM ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .99591

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	-.1625	.0443
3	-.1991	.0443

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	251.88890	251.88890		
REG(WATER/DISTILLED)	4	.13646	.03411	.32	.8657
ERROR	139	14.92250	.10736		
TOTAL	144	266.94786			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	-.1625	(-.7131 , .3880)	.0443	(-.0835 , .1721)
3	-.1991	(-.7646 , .3664)	.0443	(-.0874 , .1759)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR SELENIUM ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	1	2	1	2	1	2	1	2
TRUE CONC:	11.60	10.00	11.60	10.00	11.60	10.00	11.60	10.00
LAB NUMBER								
1	8.30*	4.90*	3.04*	0.75*	0.71* -	0.13* -	1.89*	0.30*
2	9.80	8.70 <	8.00* <	8.00* <	8.00* <	8.00* <	8.00* <	8.00*
3	21.30*	20.70*	5.80	1.20 <	0.60* <	0.60* <	0.60*	1.20
4	13.10	8.70	66.00*	10.00	13.00	12.00	15.00	11.00
5	6.50	2.20*	9.00	1.00	22.00	7.00	22.00*	14.00*
6	9.70	7.30 <	0.50* <	0.50*	9.00	2.00	2.00	2.00
7	14.00	8.70	8.00	7.00	12.00	9.00	3.00	1.00
8	13.10	10.90	6.00	7.00	9.00	2.00	10.00	7.00
9	10.40	9.00	23.20*	13.20	2.70	6.70 -	25.00* -	27.00*
10	16.30*	10.90*	5.00	10.00	15.00	10.00	15.00	10.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR SELENIUM ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	3	4	3	4	3	4	3	4
TRUE CONC:	73.00	92.60	73.00	92.60	73.00	92.60	73.00	92.60
LAB NUMBER								
1	44.50*	47.20*	23.40*	32.20*	16.00*	17.10*	15.90*	16.55*
2	51.10	71.80	58.00	74.00	37.00*	46.00*	18.00	23.00
3	118.00*	162.00*	72.20	92.20	76.70	104.00	31.90	90.90
4	74.00	89.20	63.00	79.00	16.00*	98.00	52.00	66.00
5	71.80	84.90	62.00	73.00	90.00	65.00	67.00*	97.00*
6	75.00	101.00	60.00	92.00	105.00	108.00	100.00	131.00
7	55.00	59.00	37.00	44.00	58.00	67.00	35.00	44.00
8	92.50	99.00	74.00	87.00	85.00	93.00	69.00	95.00
9	59.20	77.30	52.20	61.60	88.20	110.00	25.00	21.00
10	97.90*	131.00*	85.00	105.00	85.00	115.00	90.00	100.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR SELENIUM ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	5	6	5	6	5	6	5	6
TRUE CONC:	197.00	235.00	197.00	235.00	197.00	235.00	197.00	235.00
LAB NUMBER								
1	38.80*	62.50*	63.40*	74.90*	46.00*	61.70*	44.70*	49.20*
2	169.00	197.00	136.00	166.00	145.00*	163.00*	98.00	100.00
3	292.00*	368.00*	243.00	301.00*	237.00	237.00	226.00	293.00
4	228.00	261.00	170.00	210.00	200.00	220.00	160.00	200.00
5	159.00	207.00	101.00	183.00	281.00	357.00	235.00*	357.00*
6	211.00	237.00	169.00	208.00	263.00	223.00	229.00	263.00
7	185.00	218.00	197.00	207.00	197.00	247.00	135.00	235.00
8	212.00	218.00	177.00	194.00	138.00	178.00	148.00	173.00
9	164.00	172.00	161.00	181.00	176.00	212.00	142.00	99.70*
10	229.00*	261.00*	225.00	245.00	225.00	305.00	200.00	250.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON SELENIUM ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = 1.00959

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	-.9856	.1710
3	-.6253	.1353
4	-1.4455	.2367

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	326.21277	326.21277		
REG(WATER/DISTILLED)	6	7.08554	1.18092	6.33	.0000
ERROR	159	29.68013	.18667		
TOTAL	166	362.97844			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	-.9856	(-1.8755 , -.0957)	.1710	(-.0328 , .3747)
3	-.6253	(-1.4822 , .2316)	.1353	(-.0642 , .3348)
4	-1.4455	(-2.3520 , -.5390)	.2367	(.0282 , .4453)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR SELENIUM ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	7	6	5	7	7	7	5	6
TRUE CONC (C) UG/L	11.60	10.00	11.60	10.00	11.60	10.00	11.60	10.00
MEAN RECOVERY (X)	10.94	8.88	6.76	7.06	11.81	6.96	9.00	5.37
ACCURACY(%REL ERROR)	-5.67	-11.17	-41.72	-29.43	1.85	-30.43	-22.41	-46.33
OVERALL STD DEV (S)	2.63	1.16	1.67	4.58	5.98	3.83	6.28	4.55
OVERALL REL STD DEV, %	24.04	13.02	24.70	64.95	50.58	55.07	69.83	84.83
SINGLE STD DEV, (SR)	1.19		3.55		4.17		1.36	
ANALYST REL DEV, %	12.01		51.33		44.45		18.93	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	7	7	9	9	7	8	8	8
TRUE CONC (C) UG/L	73.00	92.60	73.00	92.60	73.00	92.60	73.00	92.60
MEAN RECOVERY (X)	68.37	83.17	62.60	78.64	83.99	95.00	52.61	71.36
ACCURACY(%REL ERROR)	-6.34	-10.18	-14.25	-15.07	15.05	2.59	-27.93	-22.93
OVERALL STD DEV (S)	14.32	15.03	13.77	18.27	14.29	19.17	30.73	39.59
OVERALL REL STD DEV, %	20.95	18.07	21.99	23.23	17.02	20.18	58.42	55.47
SINGLE STD DEV, (SR)	5.48		5.28		13.28		13.95	
ANALYST REL DEV, %	7.23		7.48		14.84		22.50	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	7	7	9	8	8	8	8	7
TRUE CONC (C) UG/L	197.00	235.00	197.00	235.00	197.00	235.00	197.00	235.00
MEAN RECOVERY (X)	189.71	215.71	175.44	199.25	214.63	247.38	167.25	216.29
ACCURACY(%REL ERROR)	-3.70	-8.21	-10.94	-15.21	8.95	5.27	-15.10	-7.96
OVERALL STD DEV (S)	27.30	28.44	43.10	24.13	46.66	57.14	46.65	64.83
OVERALL REL STD DEV, %	14.39	13.18	24.57	12.11	21.74	23.10	27.89	29.97
SINGLE STD DEV, (SR)	10.45		16.07		28.02		22.23	
ANALYST REL DEV, %	5.15		8.58		12.13		11.59	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 1
3 - EFFLUENT 2
4 - EFFLUENT 3

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR SILVER ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	1	2	1	2	1	2
TRUE CONC:	0.45	0.59	0.45	0.59	0.45	0.59
LAB NUMBER						
1	0.72	0.83	0.63	0.82	0.91	0.95
2	0.70	0.70 <	0.70* <	0.70*	0.90	0.40
3	< 0.90* <	0.90*	1.20 <	0.90*	1.50 <	0.90*
4	0.60	0.60	0.60	0.60	0.60	0.50
5	2.00*	1.00*	1.00	1.00 <	1.00*	1.00
6	< 0.05* <	0.05*	2.80	1.00	0.10	0.30
7	1.00	1.00	26.00*	19.00*	15.00*	20.00
8	< 0.50* <	0.50* <	0.50* <	0.50* <	0.50*	28.00
9	0.15	0.28 -	1.65* <	0.20*	1.56 <	0.20*
10	0.50	1.00	2.60	0.60	0.40	0.50

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR SILVER ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	3	4	3	4	3	4
TRUE CONC:	5.68	4.09	5.68	4.09	5.68	4.09
LAB NUMBER						
1	5.87	4.60	6.23	4.41	4.82	3.45
2	6.20	3.70	4.90	2.80	5.10	3.70
3	5.20	3.70	5.70	4.10 <	0.90* <	0.90*
4	5.90	4.00	5.70	4.00	5.50	3.10
5	6.00*	7.00*	6.00	4.00	6.00	4.00
6	4.60	3.80	7.10	4.20	5.60	4.60
7	5.00	3.00	4.00	2.00	5.00	2.00
8	5.30*	2.40*	4.70	2.90	7.40	4.90
9	5.22	3.37 -	1.92* -	2.20*	2.18	1.31
10	6.50	5.00	6.60	4.40	5.00	3.60

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR SILVER ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	5	6	5	6	5	6
TRUE CONC:	11.40	13.60	11.40	13.60	11.40	13.60
LAB NUMBER						
1	8.83	12.85	13.17	14.12	10.60	15.40
2	11.90	14.20	10.40	12.60	9.60	11.00
3	10.20	12.50	10.30	14.10	5.60	9.60
4	11.00	13.00	11.00	14.00	11.00	12.00
5	18.00*	26.00*	13.00	18.00	7.00	10.00
6	13.00	15.00	15.00	13.00	9.60	11.60
7	8.00	21.00	9.00	12.00	9.00	12.00
8	7.00*	11.00*	9.80	10.50	13.00	17.00
9	3.72	13.20	1.50*	1.77*	3.49	2.06*
10	14.00	19.00	14.00	16.00	11.50	13.50

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR SILVER ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3	
LOW YOUDEN PAIR	1	2	1	2	1	2
NUMBER OF DATA POINTS	6	6	6	5	7	8
TRUE CONC (C) UG/L	0.45	0.59	0.45	0.59	0.45	0.59
MEAN RECOVERY (X)	0.61	0.73	1.47	0.80	0.85	6.46
ACCURACY(%REL ERROR)	34.43	24.37	223.44	36.04	87.44	992.43
OVERALL STD DEV (S)	0.28	0.27	0.98	0.20	0.54	11.04
OVERALL REL STD DEV, %	46.01	37.31	66.59	24.90	63.51	171.00
SINGLE STD DEV, (SR)	0.14		0.76		0.19	
ANALYST REL DEV, %	20.35		67.15		5.28	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4
NUMBER OF DATA POINTS	8	8	9	9	9	9
TRUE CONC (C) UG/L	5.68	4.09	5.68	4.09	5.68	4.09
MEAN RECOVERY (X)	5.56	3.90	5.66	3.65	5.18	3.41
ACCURACY(%REL ERROR)	-2.09	-4.74	-0.37	-10.87	-8.84	-16.71
OVERALL STD DEV (S)	0.65	0.64	0.98	0.86	1.37	1.15
OVERALL REL STD DEV, %	11.74	16.49	17.29	23.55	26.52	33.79
SINGLE STD DEV, (SR)	0.36		0.27		0.52	
ANALYST REL DEV, %	7.70		5.84		12.12	
HIGH YOUDEN PAIR	5	6	5	6	5	6
NUMBER OF DATA POINTS	8	8	9	9	10	9
TRUE CONC (C) UG/L	11.40	13.60	11.40	13.60	11.40	13.60
MEAN RECOVERY (X)	10.08	15.09	11.74	13.81	9.04	12.46
ACCURACY(%REL ERROR)	-11.57	10.98	2.99	1.57	-20.71	-8.42
OVERALL STD DEV (S)	3.26	3.18	2.09	2.21	2.90	2.45
OVERALL REL STD DEV, %	32.34	21.05	17.83	15.97	32.03	19.64
SINGLE STD DEV, (SR)	2.90		1.44		0.92	
ANALYST REL DEV, %	23.03		11.24		8.53	

WATER LEGEND

1 - LAB PURE WATER
2 - DRINKING WATER
3 - SURFACE WATER

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON SILVER ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .93317

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.2422	-.1706
3	.2184	-.2108

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	144.54030	144.54030		
REG(WATER/DISTILLED)	4	1.97970	.49493	1.59	.1802
ERROR	128	39.78208	.31080		
TOTAL	133	186.30207			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	.2422	(-.2089 , .6934)	-.1706	(-.4077 , .0665)
3	.2184	(-.1943 , .6312)	-.2108	(-.4345 , .0130)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE ORTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR SILVER ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	1	2	1	2	1	2	1	2
TRUE CONC:	8.48	10.70	8.48	10.70	8.48	10.70	8.48	10.70
LAB NUMBER								
1	11.40	14.70	10.80	12.50	1.20*	9.70*	7.12	10.03
2	10.50	12.80	37.20*	9.70	< 0.70*	1.20	8.70	10.70
3	8.50	10.10	8.00	8.30	< 0.90*	7.20	6.60	10.60
4	9.30	10.90	11.00	9.00	6.60	11.00	9.30	11.00
5	13.00*	18.50*	8.00	10.00	5.00	6.00	9.00	14.00
6	12.00	10.40	0.90*	1.00*	0.50	0.70	1.10*	1.30*
7	8.70	8.70	7.00	8.00	6.00	6.00	7.00	8.00
8	5.20	7.60	7.30	10.80	2.70	11.10	13.40	16.90
9	4.00*	7.50*	- 0.01*	10.70	0.81	- 0.46*	5.15*	0.67*
10	13.00*	15.20*	11.50*	13.00*	10.00*	16.00*	11.50	19.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR SILVER ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	3	4	3	4	3	4	3	4
TRUE CONC:	21.50	17.80	21.50	17.80	21.50	17.80	21.50	17.80
LAB NUMBER								
1	26.10	16.50	23.40	20.10	6.85*	7.50*	21.83	17.38
2	22.00	18.30	21.50	16.50	8.10	6.60	19.20	15.80
3	19.50	16.00	20.50	14.50	21.50	6.70	21.00	13.50
4	21.70	17.40	17.00	20.00	14.00	11.00	22.00	19.00
5	43.50*	31.50*	28.00	23.00	4.00	51.00*	34.00	28.00
6	30.40	28.30*	2.10*	1.70*	1.80	1.60	1.10*	0.90*
7	19.60	48.90*	16.00	15.00	17.00	14.00	10.00	12.00
8	20.60	16.30	19.40	14.40	18.60	14.80	29.50	263.00*
9	6.90*	17.90*	23.00	20.20	6.96	1.19	11.30*	3.69*
10	30.40*	25.00*	28.00*	21.00*	34.00*	22.00*	36.00	12.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR SILVER ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	5	6	5	6	5	6	5	6
TRUE CONC:	42.70	56.50	42.70	56.50	42.70	56.50	42.70	56.50
LAB NUMBER								
1	40.30	33.90	47.30	63.50	6.50*	7.40*	25.83	16.98
2	8.80*	11.40	43.90	52.00	32.40	45.70	27.00	31.30
3	38.90	49.70	21.00	43.70	19.30	52.50	37.30	34.00
4	39.10	59.80	41.00	53.00	24.00	21.00	39.00	36.00
5	76.10*	72.80*	61.00	71.00	26.00	36.00	52.00	32.00
6	36.40	38.00	4.20*	5.20*	3.60	4.70	4.30*	3.70*
7	41.30	36.90	28.00	40.00	10.00	20.00	12.00	28.00
8	28.30*	41.30	26.00	37.00	36.60	39.00	24.60	38.80
9	7.20*	33.40*	33.00	45.00	2.12	1.37	4.40*	4.38*
10	56.50*	76.10*	54.00*	70.00*	62.00*	66.00*	52.00	48.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR SILVER ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	7	7	6	8	6	7	8	8
TRUE CONC (C) UG/L	8.48	10.70	8.48	10.70	8.48	10.70	8.48	10.70
MEAN RECOVERY (X)	9.37	10.74	8.68	9.87	3.60	6.17	9.08	12.53
ACCURACY(%REL ERROR)	10.51	0.40	2.40	-7.71	-57.53	-42.32	7.05	17.09
OVERALL STD DEV (S)	2.27	2.40	1.76	1.48	2.64	4.15	2.36	3.77
OVERALL REL STD DEV, %	24.22	22.32	20.30	14.94	73.38	67.26	26.01	30.06
SINGLE STD DEV, (SR)	1.17		1.31		2.54		1.48	
ANALYST REL DEV, %	11.64		14.13		52.05		13.68	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	7	5	8	8	8	7	8	7
TRUE CONC (C) UG/L	21.50	17.80	21.50	17.80	21.50	17.80	21.50	17.80
MEAN RECOVERY (X)	22.84	16.90	21.10	17.96	11.49	7.98	24.19	16.81
ACCURACY(%REL ERROR)	6.25	-5.06	-1.86	0.91	-46.53	-55.14	12.52	-5.55
OVERALL STD DEV (S)	4.01	0.94	3.83	3.27	7.26	5.51	8.54	5.61
OVERALL REL STD DEV, %	17.55	5.57	18.16	18.19	63.20	69.02	35.31	33.35
SINGLE STD DEV, (SR)	1.80		2.09		3.42		5.81	
ANALYST REL DEV, %	9.08		10.69		35.09		28.36	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	5	7	8	8	8	8	8	8
TRUE CONC (C) UG/L	42.70	56.50	42.70	56.50	42.70	56.50	42.70	56.50
MEAN RECOVERY (X)	39.20	38.71	37.65	50.65	19.25	27.53	33.72	33.13
ACCURACY(%REL ERROR)	-8.20	-31.48	-11.83	-10.35	-54.91	-51.27	-21.04	-41.35
OVERALL STD DEV (S)	1.84	14.97	13.18	11.75	12.91	18.75	14.00	8.90
OVERALL REL STD DEV, %	4.70	38.67	35.01	23.20	67.04	68.11	41.51	26.85
SINGLE STD DEV, (SR)	7.97		3.21		8.22		8.40	
ANALYST REL DEV, %	20.47		7.27		35.16		25.13	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 1
3 - EFFLUENT 2
4 - EFFLUENT 3

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON SILVER ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .79850

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	-.5369	.1651
3	-1.3926	.1612
4	.1400	-.1213

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	56.25263	56.25263		
REG(WATER/DISTILLED)	6	22.27050	3.71175	15.17	.0000
ERROR	158	38.64740	.24460		
TOTAL	165	117.17053			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	-.5369	(-1.8468 , .7729)	.1651	(-.2546 , .5848)
3	-1.3926	(-2.7166 , -.0686)	.1612	(-.2612 , .5836)
4	.1400	(-1.1410 , 1.4211)	-.1213	(-.5329 , .2903)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR THALLIUM ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	1	2	1	2	1	2
TRUE CONC:	10.50	13.00	10.50	13.00	10.50	13.00
LAB NUMBER						
1	9.95	12.48	9.40	10.50	6.90	8.17
2	10.00	10.00	8.00	9.00	7.00	8.00
3	8.10*	10.40*	3.10*	4.30*	5.40	7.70
4	11.00	12.00	10.00	11.00	10.00	11.00
5	8.00	10.00	10.00	12.00	21.00*	18.00*
6	13.00*	16.00*	15.00*	10.00*	10.00	13.00
7	9.00	12.00	8.00	10.00	< 1.00*	10.00
8	8.90	8.40	6.30	< 3.00*	62.00*	7.00
9	92.50*	11.40	7.90	8.85	5.97	9.24
10	9.00*	15.00*	9.00	12.00	9.00	13.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR THALLIUM ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	3	4	3	4	3	4
TRUE CONC:	120.00	98.60	120.00	98.60	120.00	98.60
LAB NUMBER						
1	100.50	83.20	108.00	90.00	88.60	75.20
2	112.00	98.00	94.00	79.00	88.00	75.00
3	68.10*	56.80*	54.90*	44.60*	80.70	68.30
4	110.00	95.00	110.00	90.00	100.00	89.00
5	97.00	66.00	148.00	118.00	211.00*	163.00*
6	124.00*	100.00*	154.00*	139.00*	126.00	93.00
7	98.00	92.00	84.00	89.00	88.00	71.00
8	112.00	80.00	91.80	79.90	89.00	51.00
9	120.00	87.50	103.00	85.00	104.00	62.00
10	140.00*	110.00*	140.00	120.00	140.00	120.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR THALLIUM ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	5	6	5	6	5	6
TRUE CONC:	203.00	252.00	203.00	252.00	203.00	252.00
LAB NUMBER						
1	173.55	216.20	197.00	227.00	146.00	175.00
2	191.00	245.00	104.00	97.00	140.00	173.00
3	80.50*	91.00*	68.90*	83.20*	132.00	224.00
4	190.00	230.00	180.00	220.00	190.00	220.00
5	201.00	266.00	241.00	310.00	302.00*	459.00*
6	222.00*	247.00*	310.00*	358.00*	351.00*	405.00
7	185.00	225.00	125.00	150.00	120.00	140.00
8	170.00	200.00	168.00	190.00	160.00	217.00
9	134.00	197.00	166.00	182.00	172.00	206.00
10	300.00*	300.00*	260.00	240.00	220.00	300.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR THALLIUM ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3	
LOW YOUDEN PAIR	1	2	1	2	1	2
NUMBER OF DATA POINTS	6	7	8	7	7	9
TRUE CONC (C) UG/L	10.50	13.00	10.50	13.00	10.50	13.00
MEAN RECOVERY (X)	9.47	10.90	8.57	10.48	7.75	9.68
ACCURACY(%REL ERROR)	-9.76	-16.18	-18.33	-19.40	-26.16	-25.55
OVERALL STD DEV (S)	1.05	1.47	1.27	1.29	1.90	2.24
OVERALL REL STD DEV, %	11.13	13.53	14.76	12.30	24.51	23.19
SINGLE STD DEV, (SR)	1.00		0.55		0.85	
ANALYST REL DEV, %	9.77		5.80		9.80	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4
NUMBER OF DATA POINTS	7	7	8	8	9	9
TRUE CONC (C) UG/L	120.00	98.60	120.00	98.60	120.00	98.60
MEAN RECOVERY (X)	107.07	85.96	109.85	93.86	100.48	78.28
ACCURACY(%REL ERROR)	-10.77	-12.82	-8.46	-4.80	-16.27	-20.61
OVERALL STD DEV (S)	8.67	10.86	22.87	16.10	20.00	20.17
OVERALL REL STD DEV, %	8.10	12.63	20.82	17.15	19.91	25.77
SINGLE STD DEV, (SR)	7.51		7.04		8.57	
ANALYST REL DEV, %	7.78		6.92		9.58	
HIGH YOUDEN PAIR	5	6	5	6	5	6
NUMBER OF DATA POINTS	7	7	8	8	8	9
TRUE CONC (C) UG/L	203.00	252.00	203.00	252.00	203.00	252.00
MEAN RECOVERY (X)	177.79	225.60	180.13	202.00	160.00	228.89
ACCURACY(%REL ERROR)	-12.42	-10.48	-11.27	-19.84	-21.18	-9.17
OVERALL STD DEV (S)	22.02	24.46	52.85	63.62	33.00	79.66
OVERALL REL STD DEV, %	12.39	10.84	29.34	31.49	20.63	34.80
SINGLE STD DEV, (SR)	9.27		19.36		18.75	
ANALYST REL DEV, %	4.59		10.13		9.64	

WATER LEGEND

1 - LAB PURE WATER
2 - DRINKING WATER
3 - SURFACE WATER

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON THALLIUM ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = 1.00818

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	-.1063	.0069
3	-.3634	.0480

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	226.62423	226.62423		
REG(WATER/DISTILLED)	4	.56728	.14182	6.00	.0002
ERROR	124	2.92933	.02362		
TOTAL	129	230.12085			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	-.1063	(-.3970 , .1844)	.0069	(-.0589 , .0726)
3	-.3634	(-.6549 , -.0719)	.0480	(-.0171 , .1131)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE ORTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR THALLIUM ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	1	2	1	2	1	2	1	2
TRUE CONC:	10.00	12.40	10.00	12.40	10.00	12.40	10.00	12.40
LAB NUMBER								
1	2.10*	3.50*	4.95	6.74	5.20	6.20	4.70	6.32
2	6.50	9.80 <	3.00* <	3.00*	4.00	4.00	5.00	6.00
3 <	2.10*	4.50* <	2.10* <	2.10* <	2.10*	3.80* <	2.10*	3.70*
4	9.90	10.60	11.00	9.60	9.60*	13.00*	8.40	11.00
5	8.70	12.00	20.00*	29.00*	7.00	8.00	7.00*	12.00*
6	9.80*	14.00*	7.00	8.00	9.00	10.00	8.00	10.00
7	6.50	9.80	5.00	6.00	5.00	8.00	5.00*	7.00*
8 <	3.00*	8.30	5.40	5.60 <	3.00*	4.00	7.70	8.50
9	4.00	9.80	5.47	7.68	2.59	2.91	5.23	7.07
10	10.90*	11.90*	8.00	11.00	9.00*	12.00*	6.00	8.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR THALLIUM ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	3	4	3	4	3	4	3	4
TRUE CONC:	115.00	94.30	115.00	94.30	115.00	94.30	115.00	94.30
LAB NUMBER								
1	39.80*	31.60*	73.00	57.00	73.00	62.00	77.36	62.46
2	101.00	33.70*	56.00*	40.00*	61.00	50.00	88.00	72.00
3	21.80*	17.70*	51.20*	45.30*	54.80*	42.50*	65.00*	49.40*
4	109.00	96.00	99.00	120.00	110.00*	96.00*	100.00	85.00
5	83.00	100.00	291.00*	236.00*	71.00	85.00	114.00*	123.00*
6	129.00*	97.00*	84.00	70.00	75.00	59.00	79.00	68.00
7	105.00	88.00	64.00	53.00	69.00	54.00	66.00*	57.00*
8	64.60	84.60	64.00	54.00	75.00	61.00	91.50	82.20
9	103.00	85.50	83.40	69.20	78.70	67.40	94.00	79.50
10	136.00*	114.00*	109.00	109.00	189.00*	109.00*	127.00	97.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR THALLIUM ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2		EFFLUENT 3	
AMPUL NO:	5	6	5	6	5	6	5	6
TRUE CONC:	194.00	241.00	194.00	241.00	194.00	241.00	194.00	241.00
LAB NUMBER								
1	83.50*	95.40*	104.00	128.00	112.00	119.00	129.00	147.00
2	93.00	227.00	96.00*	120.00*	107.00	156.00	125.00	139.00
3	26.40*	33.00*	95.50*	120.00*	105.00*	120.00*	118.00*	193.00*
4	174.00	217.00	200.00	240.00	220.00*	240.00*	170.00	210.00
5	164.00	227.00	447.00*	540.00*	175.00*	164.00	210.00*	314.00*
6	199.00*	241.00*	124.00	146.00	119.00	134.00	123.00	146.00
7	163.00	206.00	108.00	122.00	84.00	106.00	100.00*	132.00*
8	119.00	203.00	125.00	160.00	104.00	160.00	153.00	200.00
9	181.00	85.00*	135.00	170.00	119.00	227.00	144.00	189.50
10	228.00*	282.00*	239.00	239.00	169.00*	309.00*	207.00	257.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR THALLIUM ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3		WATER 4	
LOW YOUDEN PAIR	1	2	1	2	1	2	1	2
NUMBER OF DATA POINTS	5	6	7	7	6	7	7	7
TRUE CONC (C) UG/L	10.00	12.40	10.00	12.40	10.00	12.40	10.00	12.40
MEAN RECOVERY (X)	7.12	10.05	6.69	7.80	5.46	6.16	6.43	8.13
ACCURACY(%REL ERROR)	-28.80	-18.95	-33.11	-37.07	-45.35	-50.33	-35.67	-34.46
OVERALL STD DEV (S)	2.28	1.21	2.21	1.95	2.26	2.63	1.56	1.86
OVERALL REL STD DEV, %	31.97	12.07	33.11	24.95	41.36	42.66	24.27	22.92
SINGLE STD DEV, (SR)	1.28		1.02		0.74*		0.44	
ANALYST REL DEV, %	14.85		14.03		12.70		6.03	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4	3	4
NUMBER OF DATA POINTS	6	5	7	7	7	7	7	7
TRUE CONC (C) UG/L	115.00	94.30	115.00	94.30	115.00	94.30	115.00	94.30
MEAN RECOVERY (X)	94.27	90.82	82.34	76.03	71.81	62.63	93.84	78.02
ACCURACY(%REL ERROR)	-18.03	-3.69	-28.40	-19.38	-37.55	-33.59	-18.40	-17.26
OVERALL STD DEV (S)	17.09	6.82	17.09	27.33	5.70	11.35	16.68	11.60
OVERALL REL STD DEV, %	18.13	7.51	20.75	35.95	7.93	18.13	17.77	14.87
SINGLE STD DEV, (SR)	13.38		9.29		7.37		4.74	
ANALYST REL DEV, %	14.45		11.74		10.97		5.52	
HIGH YOUDEN PAIR	5	6	5	6	5	6	5	6
NUMBER OF DATA POINTS	6	5	7	7	6	7	7	7
TRUE CONC (C) UG/L	194.00	241.00	194.00	241.00	194.00	241.00	194.00	241.00
MEAN RECOVERY (X)	149.00	216.00	147.86	172.14	107.50	152.29	150.14	184.07
ACCURACY(%REL ERROR)	-23.20	-10.37	-23.78	-28.57	-44.59	-36.81	-22.61	-23.62
OVERALL STD DEV (S)	34.95	11.31	51.31	48.94	13.03	39.53	30.25	43.07
OVERALL REL STD DEV, %	23.45	5.24	34.70	28.43	12.13	25.96	20.14	23.40
SINGLE STD DEV, (SR)	26.79		9.91		26.36		10.69	
ANALYST REL DEV, %	14.68		6.19		20.30		6.39	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 1
3 - EFFLUENT 2
4 - EFFLUENT 3

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON THALLIUM ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = 1.04062

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	-.2054	.0052
3	-.4827	.0447
4	-.2425	.0295

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	280.13304	280.13304		
REG(WATER/DISTILLED)	6	1.63231	.27205	6.88	.0000
ERROR	141	5.57431	.03953		
TOTAL	148	287.33967			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	-.2054	(-.6287 , .2180)	.0052	(-.0916 , .1021)
3	-.4827	(-.9110 , -.0544)	.0447	(-.0536 , .1431)
4	-.2425	(-.6658 , .1809)	.0295	(-.0673 , .1264)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR VANADIUM ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	1	2	1	2	1	2
TRUE CONC:	175.00	151.00	175.00	151.00	175.00	151.00
LAB NUMBER						
1	213.00*	298.00*	226.00	133.00	520.00*	543.00*
2	184.00	185.00	206.00	190.00	173.00	121.00
3	161.00	147.00	197.00	163.00	157.00	135.00
4	150.00	130.00	150.00	140.00	140.00	120.00
5	119.00	180.00	250.00	114.00	296.00*	109.00
6	242.00*	197.00	174.00	131.00	235.00*	201.00*
7	141.00	110.00	120.00	99.00	131.00	114.00
8	292.00*	180.00*	70.00	63.00	200.00	162.00
9	132.00	125.00	141.00	131.00	142.00	136.00
10	150.00	150.00	200.00	150.00	150.00	150.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR VANADIUM ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	3	4	3	4	3	4
TRUE CONC:	404.00	318.00	404.00	318.00	404.00	318.00
LAB NUMBER						
1	682.00*	612.00*	429.00	384.00	311.00	309.00
2	328.00	301.00	274.00	342.00	359.00	299.00
3	411.00	383.00	411.00	380.00	332.00	257.00
4	330.00	270.00	350.00	290.00	308.00	280.00
5	139.00	160.00	168.00	182.00	253.00	448.00
6	423.00	310.00	412.00	342.00	440.00*	413.00*
7	36.00	24.00	336.00	313.00	855.00*	878.00*
8	1040.00*	800.00*	1450.00*	1760.00*	390.00	380.00
9	247.00	179.00	305.00	261.00	332.00	256.00
10	400.00	350.00	350.00	300.00	300.00	400.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR VANADIUM ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	5	6	5	6	5	6
TRUE CONC:	982.00	855.00	982.00	855.00	982.00	855.00
LAB NUMBER						
1	1649.00*	1236.00*	881.00	861.00	1009.00	785.00
2	945.00	865.00	1001.00	766.00	980.00	928.00
3	1200.00	828.00	1330.00	1060.00	759.00	658.00
4	190.00	160.00	920.00	770.00	710.00	720.00
5	426.00	549.00	658.00	603.00	983.00	2017.00*
6	930.00	795.00	1230.00	1002.00	1102.00*	1000.00*
7	1120.00	962.00	1200.00	1040.00	1080.00	900.00
8	3620.00*	1500.00*	2970.00*	2570.00*	1000.00	830.00
9	743.00	612.00	872.00	842.00	821.00	963.00
10	1100.00	900.00	1100.00	800.00	950.00	900.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR VANADIUM ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3	
LOW YOUDEN PAIR	1	2	1	2	1	2
NUMBER OF DATA POINTS	7	8	10	10	7	8
TRUE CONC (C) UG/L	175.00	151.00	175.00	151.00	175.00	151.00
MEAN RECOVERY (X)	148.14	153.00	173.40	131.40	156.14	130.88
ACCURACY(%REL ERROR)	-15.35	1.32	-0.91	-12.98	-10.78	-13.33
OVERALL STD DEV (S)	20.89	31.39	53.85	34.78	23.59	18.35
OVERALL REL STD DEV, %	14.10	20.51	31.06	26.47	15.11	14.02
SINGLE STD DEV, (SR)	21.04		29.77		12.67	
ANALYST REL DEV, %	13.98		19.54		8.83	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4
NUMBER OF DATA POINTS	8	8	9	9	8	8
TRUE CONC (C) UG/L	404.00	318.00	404.00	318.00	404.00	318.00
MEAN RECOVERY (X)	289.25	247.13	337.22	310.44	323.13	328.63
ACCURACY(%REL ERROR)	-28.40	-22.29	-16.53	-2.38	-20.02	3.34
OVERALL STD DEV (S)	139.71	118.59	81.74	62.96	40.96	71.73
OVERALL REL STD DEV, %	48.30	47.99	24.24	20.28	12.68	21.83
SINGLE STD DEV, (SR)	28.53		30.43		67.44	
ANALYST REL DEV, %	10.64		9.40		20.69	
HIGH YOUDEN PAIR	5	6	5	6	5	6
NUMBER OF DATA POINTS	8	8	9	9	9	8
TRUE CONC (C) UG/L	982.00	855.00	982.00	855.00	982.00	855.00
MEAN RECOVERY (X)	831.75	708.88	1021.33	860.44	921.33	835.50
ACCURACY(%REL ERROR)	-15.30	-17.09	4.01	0.64	-6.18	-2.28
OVERALL STD DEV (S)	358.07	262.62	212.61	149.78	126.59	107.28
OVERALL REL STD DEV, %	43.05	37.05	20.82	17.41	13.74	12.84
SINGLE STD DEV, (SR)	100.13		74.82		83.80	
ANALYST REL DEV, %	13.00		7.95		9.54	

WATER LEGEND

1 - LAB PURE WATER
2 - DRINKING WATER
3 - SURFACE WATER

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON VANADIUM ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .87855

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	-.8929	.1859
3	-.7075	.1549

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	76.03353	76.03353		
REG(WATER/DISTILLED)	4	1.85319	.46330	3.32	.0125
ERROR	136	18.97582	.13953		
TOTAL	141	96.86254			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERCEPT(WATER-DISTILLED) INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	SLOPE(WATER-DISTILLED) INTERVAL
2	-.8929	(-2.4440 , .6582)	.1859	(-.0738 , .4455)
3	-.7075	(-2.3216 , .9067)	.1549	(-.1143 , .4242)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR VANADIUM ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2	
AMPUL NO:	1	2	1	2	1	2
TRUE CONC:	167.00	144.00	167.00	144.00	167.00	144.00
LAB NUMBER						
1	204.00*	285.00*	250.00*	199.00*	141.00	104.00
2	176.00	177.00	183.00	122.00	155.00	135.00
3	154.00	141.00	134.00	142.00	143.00	115.00
4	143.00	124.00	110.00	140.00	140.00	120.00
5	114.00	172.00	73.00*	15.00*	130.00	8.00
6	231.00*	188.00	167.00	185.00	248.00*	241.00*
7	135.00	105.00	147.00	124.00	103.00*	102.00
8	279.00*	172.00*	250.00	200.00	150.00	130.00
9	126.00	119.00	377.00*	190.00*	156.00	195.00
10	143.00	143.00	125.00	125.00	150.00	100.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR VANADIUM ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2	
AMPUL NO:	3	4	3	4	3	4
TRUE CONC:	387.00	304.00	387.00	304.00	387.00	304.00
LAB NUMBER						
1	652.00*	585.00*	498.00*	546.00*	300.00	307.00
2	313.00	288.00	357.00	448.00	443.00	267.00
3	393.00	366.00	390.00	347.00	264.00	212.00
4	315.00	258.00	280.00	300.00	280.00	250.00
5	133.00	153.00	40.00*	24.00*	674.00*	275.00
6	404.00	296.00	545.00	502.00	593.00*	500.00*
7	34.00	23.00	298.00	247.00	333.00	336.00
8	994.00*	764.00*	350.00	300.00	360.00	320.00
9	236.00	171.00	523.00*	433.00*	292.00	470.00*
10	382.00	334.00	275.00	225.00	300.00	300.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR VANADIUM ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 1		EFFLUENT 2	
AMPUL NO:	5	6	5	6	5	6
TRUE CONC:	939.00	817.00	939.00	817.00	939.00	817.00
LAB NUMBER						
1	1576.00*	1181.00*	1338.00*	1048.00*	829.00	797.00
2	903.00	827.00	1040.00	945.00	1140.00	885.00
3	1147.00	791.00	1080.00	1010.00	691.00	664.00
4	182.00	153.00	920.00	700.00	850.00	730.00
5	407.00	525.00	607.00*	573.00*	457.00	746.00
6	889.00	760.00	1280.00	1207.00	1150.00*	1050.00*
7	1070.00	919.00	667.00	570.00	1040.00	718.00
8	3459.00*	1433.00*	950.00	850.00	898.00	760.00
9	710.00	585.00	5653.00*	1113.00*	1113.00	1133.00*
10	1051.00	860.00	975.00	775.00	800.00	700.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR VANADIUM ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3	
LOW YOUDEN PAIR	1	2	1	2	1	2
NUMBER OF DATA POINTS	7	8	7	7	8	9
TRUE CONC (C) UG/L	167.00	144.00	167.00	144.00	167.00	144.00
MEAN RECOVERY (X)	141.57	146.13	159.43	148.29	145.63	112.11
ACCURACY(%REL ERROR)	-15.23	1.48	-4.53	2.98	-12.80	-22.15
OVERALL STD DEV (S)	19.96	30.07	46.99	31.50	8.77	48.66
OVERALL REL STD DEV, %	14.10	20.58	29.47	21.24	6.02	43.40
SINGLE STD DEV, (SR)	20.06		24.44		31.55	
ANALYST REL DEV, %	13.95		15.89		24.48	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4
NUMBER OF DATA POINTS	8	8	7	7	8	8
TRUE CONC (C) UG/L	387.00	304.00	387.00	304.00	387.00	304.00
MEAN RECOVERY (X)	276.25	236.13	356.43	338.43	321.50	283.38
ACCURACY(%REL ERROR)	-28.62	-22.33	-7.90	11.33	-16.93	-6.78
OVERALL STD DEV (S)	133.53	113.25	93.64	102.48	57.57	40.52
OVERALL REL STD DEV, %	48.34	47.96	26.27	30.28	17.91	14.30
SINGLE STD DEV, (SR)	27.30		38.42		45.08	
ANALYST REL DEV, %	10.66		11.06		14.91	
HIGH YOUDEN PAIR	5	6	5	6	5	6
NUMBER OF DATA POINTS	8	8	7	7	9	8
TRUE CONC (C) UG/L	939.00	817.00	939.00	817.00	939.00	817.00
MEAN RECOVERY (X)	794.88	677.50	887.43	865.29	868.67	750.00
ACCURACY(%REL ERROR)	-15.35	-17.07	5.16	5.91	-7.49	-8.20
OVERALL STD DEV (S)	342.07	250.88	185.16	210.94	215.41	67.47
OVERALL REL STD DEV, %	43.03	37.03	18.75	24.38	24.80	9.00
SINGLE STD DEV, (SR)	95.85		43.43		129.64	
ANALYST REL DEV, %	13.02		4.69		16.02	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 1
3 - EFFLUENT 2

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON VANADIUM ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .87319

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	-.7094	.1562
3	-1.3806	.2547

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	72.93324	72.93324		
REG(WATER/DISTILLED)	4	1.71256	.42814	2.37	.0562
ERROR	124	22.41261	.18075		
TOTAL	129	97.05841			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	-.7094	(-2.5922 , 1.1734)	.1562	(-.1605 , .4730)
3	-1.3806	(-3.1699 , .4086)	.2547	(-.0466 , .5559)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR VANADIUM ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - MG/L

	LAB PURE WATER		EFFLUENT 3	
AMPUL NO:	1	2	1	2
TRUE CONC:	1.58	1.36	1.58	1.36
LAB NUMBER				
1	2.48*	1.88*	1.20	1.15
2	1.88	1.37	1.43	1.15
3	1.84	1.57	1.57	1.55*
4	1.52	1.19	1.40	1.10
5	1.24*	0.93*	0.81	0.56*
6	1.57	1.35	1.04	1.24
7	1.52	1.26	1.55	1.25
8	3.40*	2.38*	1.38	1.17
9	0.91*	0.65*	0.70*	0.72*
10	1.52	1.30	1.45	1.20

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR VANADIUM ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - MG/L

	LAB PURE WATER		EFFLUENT 3	
AMPUL NO:	3	4	3	4
TRUE CONC:	2.34	2.70	2.34	2.70
LAB NUMBER				
1	4.32*	5.25*	2.46	2.38
2	2.55	2.78	2.13	2.72
3	2.06	2.36	2.69	2.86
4	2.17	2.50	2.00	2.30
5	0.88*	0.75*	1.60	1.54*
6	2.11	2.51	2.34	2.83
7	2.15	2.93	2.32	2.55
8	5.10*	4.40*	1.97	2.44
9	1.22*	1.41*	1.49*	1.80*
10	1.85	2.06	2.20	2.70

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR VANADIUM ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - MG/L

	LAB PURE WATER		EFFLUENT 3	
AMPUL NO:	5	6	5	6
TRUE CONC:	5.29	6.03	5.29	6.03
LAB NUMBER				
1	5.96*	12.23*	4.33	5.36
2	6.03	6.68	3.72	5.66
3	6.23	9.04*	4.99	3.51
4	4.56	5.87	4.80	5.40
5	0.22*	0.17*	5.76	7.86
6	4.92	6.12	6.34	7.14
7	4.92	5.82	4.08	4.93
8	8.97*	11.41*	4.63	5.20
9	2.82*	3.32*	3.12*	3.87*
10	4.35	5.98	6.20	6.20

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR VANADIUM ANALYSES BY WATER TYPE

	WATER 1		WATER 2	
LOW YOUDEN PAIR	1	2	1	2
NUMBER OF DATA POINTS	6	6	9	7
TRUE CONC (C) MG/L	1.58	1.36	1.58	1.36
MEAN RECOVERY (X)	1.64	1.34	1.32	1.18
ACCURACY(%REL ERROR)	3.95	-1.35	-16.74	-13.24
OVERALL STD DEV (S)	0.17	0.13	0.25	0.05
OVERALL REL STD DEV, %	10.29	9.71	19.10	4.54
SINGLE STD DEV, (SR)	0.08		0.13	
ANALYST REL DEV, %	5.21		10.47	
MEDIUM YOUDEN PAIR	3	4	3	4
NUMBER OF DATA POINTS	6	6	9	8
TRUE CONC (C) MG/L	2.34	2.70	2.34	2.70
MEAN RECOVERY (X)	2.15	2.52	2.19	2.60
ACCURACY(%REL ERROR)	-8.15	-6.49	-6.39	-3.77
OVERALL STD DEV (S)	0.23	0.31	0.32	0.21
OVERALL REL STD DEV, %	10.69	12.22	14.45	8.09
SINGLE STD DEV, (SR)	0.15		0.16	
ANALYST REL DEV, %	6.37		6.57	
HIGH YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	6	5	9	9
TRUE CONC (C) MG/L	5.29	6.03	5.29	6.03
MEAN RECOVERY (X)	5.17	6.09	4.98	5.70
ACCURACY(%REL ERROR)	-2.30	1.05	-5.78	-5.53
OVERALL STD DEV (S)	0.78	0.35	0.93	1.27
OVERALL REL STD DEV, %	15.05	5.71	18.64	22.23
SINGLE STD DEV, (SR)	0.27		0.75	
ANALYST REL DEV, %	4.72		13.97	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 3

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON VANADIUM ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .99654

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	-.1207	.0662

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	28.22095	28.22095		
REG(WATER/DISTILLED)	2	.07865	.03932	1.73	.1850
ERROR	74	1.68535	.02278		
TOTAL	77	29.98494			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	-.1207	(-.2787 , .0373)	.0662	(-.0686 , .2010)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ZINC ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	1	2	1	2	1	2
TRUE CONC:	0.54	0.75	0.54	0.75	0.54	0.75
LAB NUMBER						
1	3.80	4.00 -	6.00*	6.00 -	22.60*	49.00
2	4.50	16.90*	19.80	71.10*	2.80 <	0.30*
3	< 0.20*	< 0.20*	17.60 <	0.20* <	0.20* <	0.20*
4	400.00*	480.00*	500.00*	400.00*	300.00*	1000.00*
5	57.00* <	5.00*	41.00	17.00	8.00	15.00
6	< 40.00* <	40.00* <	2.00* <	2.00* <	2.00* <	2.00*
7	< 1.00* <	1.00* -	19.00* -	20.00* -	2.00*	4.00
8	2.60	3.00 <	1.00*	0.80	290.00*	320.00*
9	4658.00*	0.27 -	18.58* -	1.50* -	10.50* -	15.30*
10	1.00	2.00	1.00	1.00	0.50	5.50

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ZINC ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	3	4	3	4	3	4
TRUE CONC:	5.32	6.14	5.32	6.14	5.32	6.14
LAB NUMBER						
1	5.80	0.00*	8.10	2.10 -	10.20* -	6.20*
2	50.60	4.60	38.80	15.40	3.10	1.00
3	14.90	2.40	543.00* <	0.20* <	0.20*	207.00*
4	860.00*	360.00*	900.00*	100.00*	640.00*	720.00*
5	52.00	57.00	63.00	34.00	35.00	49.00
6	< 40.00* <	40.00* <	2.00* <	2.00* <	2.00* <	2.00*
7	5.00	3.00 -	18.00* -	20.00* <	1.00*	47.00
8	60.00	52.00	22.00	20.00	188.00*	230.00*
9	27.20	0.78 -	5.60*	284.00* -	15.30* -	11.90*
10	7.50	4.50	3.50	4.00	3.00	4.50

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ZINC ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		DRINKING WATER		SURFACE WATER	
AMPUL NO:	5	6	5	6	5	6
TRUE CONC:	13.90	17.40	13.90	17.40	13.90	17.40
LAB NUMBER						
1	18.40	18.90	3.70	17.50	- 8.60*	- 34.80*
2	42.50	58.80	176.00	135.00	4.00	8.40
3	112.00	85.00	8.00	98.00	< 0.20*	< 0.20*
4	2600.00*	670.00*	400.00*	500.00*	2200.00*	1120.00*
5	71.00	14.00	26.00	19.00	49.00	37.00
6	< 40.00*	< 40.00*	< 2.00*	< 2.00*	< 2.00*	< 2.00*
7	9.00	9.00	10.00	- 8.00*	4.00	- 1.00*
8	14.00	29.00	158.00	202.00	70.00*	370.00*
9	24.20	28.20	- 2.00*	20.30	45.00	- 5.90*
10	12.00	14.50	13.50	14.50	8.50	13.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR ZINC ANALYSES BY WATER TYPE

	WATER 1		WATER 2		WATER 3	
LOW YOUDEN PAIR	1	2	1	2	1	2
NUMBER OF DATA POINTS	4	4	4	4	3	4
TRUE CONC (C) UG/L	0.54	0.75	0.54	0.75	0.54	0.75
MEAN RECOVERY (X)	2.97	2.32	19.85	6.20	3.77	18.38
ACCURACY(%REL ERROR)	455.04	209.00	3603.36	726.67	602.74	2350.00
OVERALL STD DEV (S)	1.53	1.59	16.41	7.59	3.84	20.99
OVERALL REL STD DEV, %	51.52	68.63	82.66	122.44	102.01	114.23
SINGLE STD DEV, (SR)	0.29		12.00		1.00	
ANALYST REL DEV, %	11.12		92.13		9.03	
MEDIUM YOUDEN PAIR	3	4	3	4	3	4
NUMBER OF DATA POINTS	8	7	5	5	3	4
TRUE CONC (C) UG/L	5.32	6.14	5.32	6.14	5.32	6.14
MEAN RECOVERY (X)	27.87	17.75	27.08	15.10	13.70	25.38
ACCURACY(%REL ERROR)	423.97	189.16	409.02	145.93	157.52	313.27
OVERALL STD DEV (S)	23.07	25.18	24.34	12.98	18.45	26.18
OVERALL REL STD DEV, %	82.76	141.81	89.88	85.93	134.65	103.16
SINGLE STD DEV, (SR)	12.38		9.43		5.98	
ANALYST REL DEV, %	54.26		44.71		30.58	
HIGH YOUDEN PAIR	5	6	5	6	5	6
NUMBER OF DATA POINTS	8	8	7	7	5	3
TRUE CONC (C) UG/L	13.90	17.40	13.90	17.40	13.90	17.40
MEAN RECOVERY (X)	37.89	32.17	56.46	72.33	22.10	19.47
ACCURACY(%REL ERROR)	172.57	84.91	306.17	315.68	58.99	11.88
OVERALL STD DEV (S)	36.36	26.41	76.01	74.50	22.85	15.36
OVERALL REL STD DEV, %	95.96	82.07	134.63	103.00	103.39	78.89
SINGLE STD DEV, (SR)	17.38		32.04		6.72	
ANALYST REL DEV, %	49.62		49.75		32.31	

WATER LEGEND

1 - LAB PURE WATER
2 - DRINKING WATER
3 - SURFACE WATER

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON ZINC ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .71375

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.5557	-.1864
3	.5955	-.4219

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	41.32224	41.32224		
REG(WATER/DISTILLED)	4	5.31561	1.32890	1.13	.3506
ERROR	80	94.48602	1.18108		
TOTAL	85	141.12387			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	.5557	(-.5543 , 1.6657)	-.1864	(-.7180 , .3453)
3	.5955	(-.5886 , 1.7796)	-.4219	(-.9989 , .1551)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS AHALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ZINC ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - MG/L

	LAB PURE WATER		EFFLUENT 1	
AMPUL NO:	1	2	1	2
TRUE CONC:	1.74	1.31	1.74	1.31
LAB NUMBER				
1	1.45	1.07	1.59	1.22
2	1.59	0.94	2.08	3.20
3	9.63*	1.74 <	0.40* <	0.40*
4	2.25	1.39	1.60	1.70
5	0.02*	0.01*	0.01	0.09
6	1.97	1.24 <	0.00* -	0.28*
7	1.06	0.95	1.85*	2.65*
8	1.37	1.19	0.05	1.64
9	0.69	0.66	0.52	1.99
10	1.60	2.14	1.00 -	0.50*

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ZINC ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - MG/L

	LAB PURE WATER		EFFLUENT 1	
AMPUL NO:	3	4	3	4
TRUE CONC:	3.40	2.83	3.40	2.83
LAB NUMBER				
1	3.40	2.45	3.78	2.94
2	6.03	5.08	3.67	2.19
3	7.32	1.14 <	0.40* <	0.40*
4	4.28	3.39	3.30	3.20
5	0.23*	0.02*	0.04	0.03
6	3.89	3.17	0.48	0.12
7	3.84	2.96	3.98*	3.74*
8	5.41	5.65	1.66	2.47
9	6.44	0.02	1.09	5.54
10	3.74	3.18	4.00	2.50

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ZINC ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - MG/L

	LAB PURE WATER		EFFLUENT 1	
AMPUL NO:	5	6	5	6
TRUE CONC:	5.19	6.41	5.19	6.41
LAB NUMBER				
1	5.15	5.69	5.37	6.01
2	4.38	4.02	3.26	4.38
3	13.57*	3.91 <	0.40* <	0.40*
4	6.25	7.10	5.60	8.20
5	0.03*	0.02*	0.04	0.05
6	6.11	7.17	0.96	1.44
7	5.29	5.61	7.40*	7.10*
8	8.30	7.93	0.06	3.35
9	3.73	4.83	2.75	1.88
10	6.36	6.89	4.00	6.00

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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR ZINC ANALYSES BY WATER TYPE

	WATER 1		WATER 2	
LOW YOUDEN PAIR	1	2	1	2
NUMBER OF DATA POINTS	8	9	7	6
TRUE CONC (C) MG/L	1.74	1.31	1.74	1.31
MEAN RECOVERY (X)	1.50	1.26	0.98	1.64
ACCURACY(%REL ERROR)	-13.92	-3.91	-43.78	25.13
OVERALL STD DEV (S)	0.49	0.45	0.81	1.01
OVERALL REL STD DEV, %	32.53	35.69	83.21	61.91
SINGLE STD DEV, (SR)	0.32		0.59	
ANALYST REL DEV, %	23.30		44.85	
MEDIUM YOUDEN PAIR	3	4	3	4
NUMBER OF DATA POINTS	9	9	8	8
TRUE CONC (C) MG/L	3.40	2.83	3.40	2.83
MEAN RECOVERY (X)	4.93	3.01	2.25	2.37
ACCURACY(%REL ERROR)	45.01	6.19	-33.76	-16.14
OVERALL STD DEV (S)	1.41	1.74	1.61	1.76
OVERALL REL STD DEV, %	28.55	57.82	71.63	74.10
SINGLE STD DEV, (SR)	1.77		1.35	
ANALYST REL DEV, %	44.65		58.50	
HIGH YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	8	9	8	8
TRUE CONC (C) MG/L	5.19	6.41	5.19	6.41
MEAN RECOVERY (X)	5.70	5.91	2.75	3.91
ACCURACY(%REL ERROR)	9.75	-7.88	-46.92	-38.95
OVERALL STD DEV (S)	1.40	1.45	2.22	2.75
OVERALL REL STD DEV, %	24.62	24.62	80.70	70.21
SINGLE STD DEV, (SR)	0.41		0.98	
ANALYST REL DEV, %	7.02		29.45	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 1

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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ZINC ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 2	
AMPUL NO:	1	2	1	2
TRUE CONC:	30.20	24.60	30.20	24.60
LAB NUMBER				
1	25.60	20.00	- 50.00*	- 71.00*
2	28.30	17.60	24.60	9.50
3	171.00*	32.60	52.40	< 0.20*
4	39.90	26.00	4300.00*	500.00*
5	0.36*	0.20*	95.00	< 5.00*
6	35.00	23.20	360.00*	- 240.00*
7	18.80	17.80	28.00	9.00
8	24.30	22.20	< 1.00*	< 1.00*
9	12.30	12.40	41.10	41.10
10	28.50	40.00	30.00	40.00

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ZINC ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 2	
AMPUL NO:	3	4	3	4
TRUE CONC:	50.70	65.00	50.70	65.00
LAB NUMBER				
1	50.90	55.60	- 36.00*	74.00
2	90.20	115.00	66.00	55.70
3	109.00	25.90	21.90	28.40
4	64.00	76.80	800.00*	1800.00*
5	3.50*	0.53*	65.00	58.00
6	58.20	71.80	1200.00*	1080.00*
7	57.40	67.00	41.00	44.00
8	81.00	128.00	300.00	120.00
9	96.30	0.53	203.00	38.70
10	56.00	72.00	60.00	80.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ZINC ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 2	
AMPUL NO:	5	6	5	6
TRUE CONC:	148.00	189.00	148.00	189.00
LAB NUMBER				
1	146.00	167.00	111.00	- 6.00*
2	124.00	117.00	63.70	36.90
3	384.00*	114.00	154.00	< 0.20*
4	177.00	208.00	200.00*	300.00*
5	0.99*	0.68*	18.00	35.00
6	173.00	210.00	360.00	120.00
7	150.00	164.00	204.00	174.00
8	235.00	232.00	1960.00*	1670.00*
9	106.00	141.00	170.00	357.00
10	180.00	202.00	160.00	110.00

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON ZINC ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = 1.10687

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	.1363	-.5418

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	21.03910	21.03910		
REG(WATER/DISTILLED)	2	6.71588	3.35794	4.23	.0178
ERROR	84	66.69991	.79405		
TOTAL	87	94.45489			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	.1363	(-.8154 , 1.0880)	-.5418	(-1.2834 , .1997)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR ZINC ANALYSES BY WATER TYPE

	WATER 1		WATER 2	
LOW YOUDEN PAIR	1	2	1	2
NUMBER OF DATA POINTS	8	9	6	4
TRUE CONC (C) UG/L	30.20	24.60	30.20	24.60
MEAN RECOVERY (X)	26.59	23.53	45.18	24.90
ACCURACY(%REL ERROR)	-11.96	-4.34	49.61	1.22
OVERALL STD DEV (S)	8.66	8.41	26.46	18.08
OVERALL REL STD DEV, %	32.59	35.74	58.56	72.60
SINGLE STD DEV, (SR)	5.83		9.52	
ANALYST REL DEV, %	23.26		27.17	
MEDIUM YOUDEN PAIR	3	4	3	4
NUMBER OF DATA POINTS	9	9	7	8
TRUE CONC (C) UG/L	50.70	65.00	50.70	65.00
MEAN RECOVERY (X)	73.67	68.07	108.13	62.35
ACCURACY(%REL ERROR)	45.30	4.72	113.27	-4.08
OVERALL STD DEV (S)	20.96	39.36	103.04	28.99
OVERALL REL STD DEV, %	28.46	57.83	95.30	46.49
SINGLE STD DEV, (SR)	34.77		60.72	
ANALYST REL DEV, %	49.06		71.24	
HIGH YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	8	9	8	6
TRUE CONC (C) UG/L	148.00	189.00	148.00	189.00
MEAN RECOVERY (X)	161.38	172.78	155.09	138.82
ACCURACY(%REL ERROR)	9.04	-8.58	4.79	-26.55
OVERALL STD DEV (S)	39.60	42.83	102.62	119.32
OVERALL REL STD DEV, %	24.54	24.79	66.17	85.96
SINGLE STD DEV, (SR)	11.72		96.74	
ANALYST REL DEV, %	7.01		65.83	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 2

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON ZINC ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = 1.01292

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	1.6857	-.3539

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	37.81808	37.81808		
REG(WATER/DISTILLED)	2	2.13765	1.06882	1.86	.1622
ERROR	78	44.77322	.57402		
TOTAL	81	84.72895			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	INTERVAL
2	1.6857	(-.4529 , 3.8242)	-.3539	(-.8522 , .1443)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE ORTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ZINC ANALYSIS BY WATER TYPE
LOW YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 3	
AMPUL NO:	1	2	1	2
TRUE CONC:	0.51	0.72	0.51	0.72
LAB NUMBER				
1	3.60	3.80	- 268.00*	- 190.00*
2	4.30	16.20*	2.00	< 0.30*
3	< 0.20*	< 0.20*	< 0.20*	< 0.20*
4	384.00*	461.00*	880.00*	1200.00*
5	55.00*	0.50	28.00	20.00
6	< 40.00*	< 40.00*	- 30.00*	330.00
7	< 1.00*	< 1.00*	55.00	- 2.00*
8	2.50	2.90	< 1.00*	< 1.00*
9	4472.00*	0.26	2670.00*	33.30
10	0.96	1.90	15.00	< 1.00*

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ZINC ANALYSIS BY WATER TYPE
MEDIUM YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 3	
AMPUL NO:	3	4	3	4
TRUE CONC:	5.09	5.87	5.09	5.87
LAB NUMBER				
1	5.60	< 1.00*	- 232.00*	- 83.00*
2	48.60	4.40	8.90	- 11.00*
3	14.30	2.30	1210.00*	267.00
4	826.00*	346.00*	1500.00*	2400.00*
5	49.90	54.70	10.00	< 5.00*
6	< 40.00*	< 40.00*	90.00	150.00
7	4.80	2.90	< 1.00*	- 1.00*
8	57.60	49.90	32.00	86.00
9	26.10	0.74	17.40	9.64
10	7.20	4.30	46.50	46.50

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

RAW DATA FOR ZINC ANALYSIS BY WATER TYPE
HIGH YOUDEN PAIR, UNITS - UG/L

	LAB PURE WATER		EFFLUENT 3	
AMPUL NO:	5	6	5	6
TRUE CONC:	13.30	16.70	13.30	16.70
LAB NUMBER				
1	17.70	18.10	- 167.00*	- 64.00*
2	40.80	56.40	< 0.30*	< 0.30*
3	108.00	81.60	< 0.20*	276.00
4	2496.00*	643.00*	1900.00*	2500.00*
5	68.20	13.40	< 5.00*	14.00
6	< 40.00*	< 40.00*	50.00	60.00
7	8.60	8.60	3.00	4.00
8	13.40	27.80	477.00*	290.00
9	23.20	27.10	44.00	29.30
10	11.50	13.90	14.50	32.50

ENVIRONMENTAL MONITORING AND SUPPORT LABORATORY
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ENVIRONMENTAL PROTECTION AGENCY

*** EPA METHOD STUDY - TRACE METALS BY AA ***

STATISTICAL SUMMARY FOR ZINC ANALYSES BY WATER TYPE

	WATER 1		WATER 2	
LOW YOUDEN PAIR	1	2	1	2
NUMBER OF DATA POINTS	4	5	4	3
TRUE CONC (C) UG/L	0.51	0.72	0.51	0.72
MEAN RECOVERY (X)	2.84	1.87	25.00	127.77
ACCURACY(%REL ERROR)	453.61	161.09	4773.29	17719.62
OVERALL STD DEV (S)	1.46	1.52	22.64	175.27
OVERALL REL STD DEV, %	51.27	81.26	90.57	137.18
SINGLE STD DEV, (SR)	0.27		UND	
ANALYST REL DEV, %	11.49		UND	
MEDIUM YOUDEN PAIR	3	4	3	4
NUMBER OF DATA POINTS	8	7	6	5
TRUE CONC (C) UG/L	5.09	5.87	5.09	5.87
MEAN RECOVERY (X)	26.76	17.03	34.13	111.83
ACCURACY(%REL ERROR)	425.79	190.19	570.60	1805.08
OVERALL STD DEV (S)	22.14	24.16	30.91	101.13
OVERALL REL STD DEV, %	82.73	141.85	90.56	90.44
SINGLE STD DEV, (SR)	11.89		25.01	
ANALYST REL DEV, %	54.30		34.28	
HIGH YOUDEN PAIR	5	6	5	6
NUMBER OF DATA POINTS	8	8	4	7
TRUE CONC (C) UG/L	13.30	16.70	13.30	16.70
MEAN RECOVERY (X)	36.42	30.86	27.88	100.83
ACCURACY(%REL ERROR)	173.87	84.81	109.59	503.76
OVERALL STD DEV (S)	35.06	25.36	22.71	125.72
OVERALL REL STD DEV, %	96.24	82.16	81.47	124.69
SINGLE STD DEV, (SR)	16.74		9.92	
ANALYST REL DEV, %	49.76		15.41	

WATER LEGEND

1 - LAB PURE WATER
2 - EFFLUENT 3

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*** EPA METHOD STUDY - TRACE METALS BY AA ***

EFFECT OF WATER TYPE ON ZINC ANALYSIS

** POINT ESTIMATES **

DISTILLED WATER SLOPE:GAMMA(1) = .84336

WATER	INTERCEPT(WATER-DISTILLED)	SLOPE(WATER-DISTILLED)
2	2.4134	-.8250

** ANALYSIS OF VARIANCE **

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F	PROB
REG(DISTILLED)	1	20.92135	20.92135		
REG(WATER/DISTILLED)	2	33.74910	16.87455	14.73	.0000
ERROR	57	65.31854	1.14594		
TOTAL	60	119.98899			

** TABLE OF 95% CONFIDENCE INTERVALS FOR THE DIFFERENCES BETWEEN INTERCEPTS AND THE DIFFERENCES BETWEEN SLOPES **

WATER	INTERCEPT(WATER-DISTILLED) ESTIMATE	INTERCEPT(WATER-DISTILLED) INTERVAL	SLOPE(WATER-DISTILLED) ESTIMATE	SLOPE(WATER-DISTILLED) INTERVAL
2	2.4134	(1.4131 , 3.4137)	-.8250	(-1.3086 , -.3414)

NOTE: IF ZERO IS CONTAINED WITHIN A GIVEN CONFIDENCE INTERVAL THEN THERE IS NO STATISTICAL SIGNIFICANCE BETWEEN DISTILLED WATER AND THE CORRESPONDING WASTE WATER FOR THE ASSOCIATED PARAMETER(INTERCEPT/SLOPE).

THE SLOPE AND INTERCEPT ESTIMATES FROM THIS ANALYSIS ARE NOT THE SAME AS THOSE OBTAINED FROM THE PRECISION AND ACCURACY REGRESSIONS PERFORMED EARLIER.